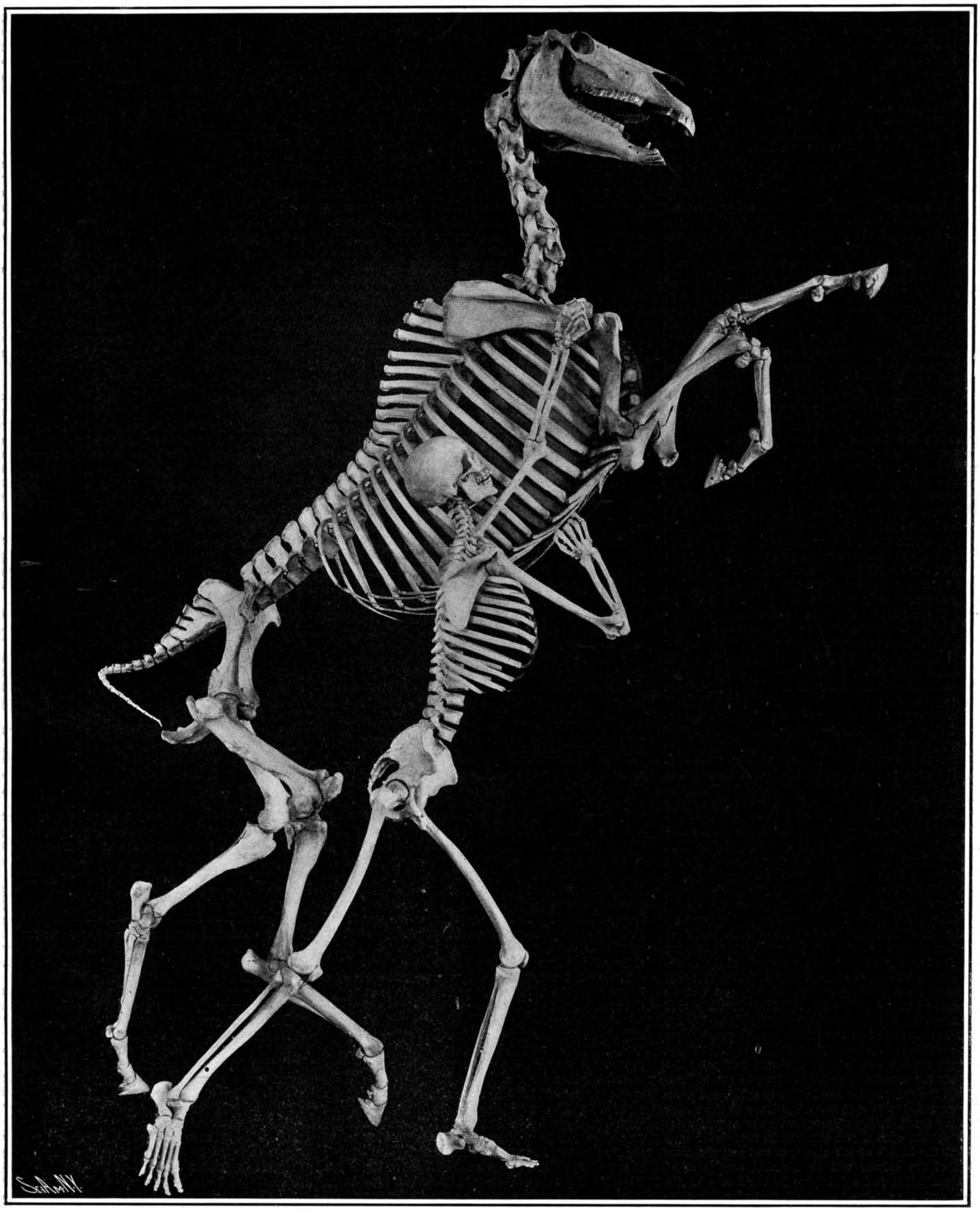
SCIENTIFIC AMERICAN
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1905, by Munn & Co.]
Vol. XCIII.—No. 5. ESTABLISHED 1845.] NEW YORK, JULY 29, 1905. [8 CENTS A COPY. $3.00 A YEAR.



Skeleton of a Man and of a Horse Mounted for Comparison. Man Has Retained More of the Primitive Features Common to All Mammals, the Horse Being Far More Specialized in the Structure of Its Limbs and of Its Grinding Teeth.

THE EVOLUTION OF THE HORSE.—[See page 81.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

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Scientific American (Established 1845) .... $3.00 a year
Scientific American Supplement (Established 1876) .... 5.00 "
American Homes and Gardens .... 3.00 "
Scientific American Export Edition (Established 1878) .... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JULY 29, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

SANITATION AND SUBSISTENCE AT PANAMA.

President Roosevelt has likened the stragglers that have drifted home from Panama, with their mouths full of censure and complaint, to the few faint-hearted and garrulous soldiers that fall back to the rear when the battle is on in good earnest. Nobody supposes that the Isthmus of Panama is just now either a health or a pleasure resort; but that affairs down there are as bad as they are represented to be by a few disappointed adventurers, no one whose judgment is entitled to respect believes for one moment. At the same time, it does begin to look as though we had entered upon active construction without making that special preparation for the reception, housing, subsistence of the working force, which the very trying conditions at the Isthmus render necessary.

In a recent article we dwelt upon the necessity of regarding the construction of the canal, at least as far as its engineering features are concerned, as a one-man job; but the success of the engineer will be dependent, other things being equal, upon effective organization for insuring the complete sanitation of the Isthmus and the comfortable subsistence of the large body of men employed. It is gratifying to note that the War Department has intrusted to the Medical Department of the army the care of the health of the employes in the canal zone. It is too early yet to judge of the efficiency with which this department is carrying on its work; but we have an earnest of what will be done at Panama, in the great success that has attended our efforts to stamp out yellow fever in the West Indies. When a modern system of drainage and water supply has been built at Panama and Colon; when the swamps have been drained, and the mosquito pest brought under control, white labor, if it is careful to observe the rules of hygiene laid down by the Medical Department, will be able to live and work at Panama, with a rate of disease and mortality that will compare favorably with any other place in the tropics.

Second only in importance to sanitation is that of subsistence, and in this connection we notice that our esteemed contemporary, the Army and Navy Journal, makes the very sensible suggestion that the next logical step to turning over to the Medical Department of the army the matter of sanitation, would be to hand over to the Subsistence Department the equally important work of feeding and housing the large body of workingmen engaged at Panama. Our experience in the Philippines, where this department has been very successful in taking care of large bodies of men who hitherto have never lived in any but a temperate zone, will be invaluable in caring for the veritable army of employes that will be gathered at Panama by the time the work is in full swing. By all means, let the army have charge of this work. It would be courting disaster to farm out the privilege of housing and feeding the employes to professional boarding-house keepers, most of whom in all probability will have had no experience of tropical life, and will be ignorant as to the proper kind of food for the severe conditions of the climate. The Subsistence Department has succeeded in the Philippines in providing a ration which combines sufficient variety and nutriment to meet all the demands of the men and minimize grounds for complaint, and, according to our contemporary, the army ration used there is equal, and probably superior, to that of any other army in the world. Another consideration that indicates the necessity for army control of food and quarters is, that under such control the health of the employes and not the mere profit of the caterer will be the first consideration. With sanitation and subsistence in the hands of the army, and the work of construction under the absolute control of a chief engineer, the people of the United States may rest perfectly satisfied that the Panama Canal will be built expeditiously, economically, and at a very small cost of life.

THE FIRST AND LAST OF ITS TYPE.

Several years ago, when the 16-inch army gun, the most powerful weapon in the world, was in the initial stage of its construction, the SCIENTIFIC AMERICAN predicted that as it was the first, so it would be the last, of its type to be built. The prediction was made at the time when the then new smokeless powders were beginning to demonstrate their remarkable ballistic powers. At that time our guns were using brown powder, and they were built in lengths of not over 30 or 35 calibers; muzzle velocities were low, not exceeding 2,000 or 2,100 feet per second; and a gun of large caliber using a projectile of great weight was necessary, in order to insure penetration of the heaviest armor at what was then considered to be the extreme ranges at which the guns of a fortification would open on the enemy. At the time that its dimensions were decided upon, the 16-inch gun was by far the most powerful weapon in existence, a distinction, indeed, which it carries at the present day. With the development of smokeless powders, and the corresponding increase in the length of the guns to enable the powder to exercise its full effect, the velocities rose at a truly astonishing rate; and as the energy of the projectile increases as the square of the velocity and only directly as the weight, it can be seen that the advantages of weight in gun and projectile became relatively less pronounced. Guns with a muzzle velocity of 2400, 2600, and 2800 feet per second were built in rapid succession by foreign gunmakers. Ultimately, guns of moderate caliber but of great length were produced, whose penetrating power was equal to, and even greater than, that of the huge and unwieldy guns of 16 and 17-inch caliber which had been constructed by the British and the Italian governments. When the 16-inch gun was fired under test at Sandy Hook, some two or three years ago, it developed a muzzle velocity of 2300 feet per second, and a muzzle energy of about 88,000 foot-tons. This rendered it, at once, the most powerful gun in existence, the Armstrong 16¼-inch gun having an energy of only about 54,000 foot-tons. The great object aimed at in armor-piercing guns is penetration. If a 12-inch gun can be built which will give sufficient velocity to its 850-pound projectile to carry it through the heaviest ship's armor at from 3,000 to 5,000 feet range and explode the shell within the ship, it is sufficient. The present 40-caliber 12-inch gun of the navy has a muzzle velocity of 2800 foot-seconds and a muzzle energy of over 46,000 foot-tons. Vickers-Maxim build a 12-inch 45-caliber gun, with a muzzle velocity of 3,000 foot-seconds and a muzzle energy of 53,000 foot-tons. Its projectile is capable of penetrating 52 inches of wrought-iron plate at the muzzle, or 40 inches of mild steel, while at 3,000 yards range it will pass through 19.6 inches of hard steel. With a 12-inch gun weighing only 57 tons, capable of doing such work as this, a 130-ton, 16-inch gun becomes superfluously heavy and cumbersome, to say nothing of its weight, cost, and slowness of fire. The 16-inch gun will be mounted at Sandy Hook, and form part of the defenses there. Historically, it will ever be of interest as marking a turning point in the development of modern high-power ordnance.

THE TURBINE STEAMERS ON THE CANADIAN ROUTE.

Naval designers and the manufacturers of marine engines are following with close observation the performance of the two turbine-driven steamships of the Allan Line, both of which are now running regularly in the service of the company. This is the first application of the new motive power to large ocean liners, and it is realized that upon the results obtained with these ships will depend, very largely, the future of turbine propulsion, at least for this type of service. The first voyage of the "Victorian" gave only rather indifferent results, although it was understood that the low speed was due largely to unfavorable weather and fog. In her later trips, however, this ship has shown excellent results, better than any achieved by earlier ships of this line using reciprocating engines.

The second vessel, the "Virginian," has done even better than the "Victorian," and is steadily reducing the record across the ocean, over the route which she follows. On a recent trip to Montreal, she left Moville at 2:45 P. M. on June 9, and arrived at Rimouski at 4:15 P. M. (local time) June 15, the total time of the passage being only six days, six hours, and thirty minutes. Allowing for a detention by fog of three hours and thirty minutes off Cape Race, the net time of the passage figures out as six days and three hours, and the average speed as 17.05 knots an hour. The advantage of this faster service is shown by the fact that the Montreal mail, which left Ireland twenty-six hours ahead of the "Virginian," on board the "Baltic" for New York, was distributed in Montreal nine hours later than the mail carried by the "Virginian." On both new steamers the passengers and the officers of the ship have testified to the remarkable smoothness of the turbine, the absence of vibration reminding the latter of the smooth motion of a sailing ship.

THE FUTURE OF THE GAS-PRODUCER ENGINE.

In explanation of the fact that gas-producer power plants have received less attention in America than abroad, Mr. S. S. Wyatt, in a paper read before the American Institution of Mining Engineers, offered the following causes: Lack of general knowledge of the subject, and a certain measure of prejudice; the novelty of the work; the inadaptability of the gas engine to certain classes of work; the comparative cheapness of fuel, rendering economy a less urgent question; and lastly, the fact that the smoke nuisance has not made itself so felt as to call for serious attention. The author, however, believes that we are within measurable distance of the time when the gas-producer locomotive, portable engine, and marine engine will be in general use. In the issue of the SCIENTIFIC AMERICAN SUPPLEMENT of February 4, 1905, we gave illustrations of the application of the gas producer to the locomotive and to the marine engine. The arguments adduced in that article are indorsed in the paper above referred to. The advantages of the gas-producer locomotive would be that both trains and stations might be kept cleaner; that the locomotives, being cinderless, the danger of fire due to sparks would be eliminated, and insurance rates would be proportionately reduced. Mr. Wyatt estimates that the amount of fuel used for a given amount of work would be less than 50 per cent of that now required on steam locomotives, and that the amount of water used would be less than one-eighth. This would have the incidental advantage of saving the time now required in loading up with fuel and water, besides effecting a reduction in the number of fuel and water stations that would be required. The danger of boiler explosions would also be eliminated. In the portable engine similar advantages would accrue, particularly as regards the reduction of fire losses and the decrease in insurance rates. In the marine engine the gas-producer plant would confer equal, if not greater, advantages, particularly as to cleanliness, for the absence of smoke and cinders would make it possible to keep the ships cleaner, and the comfort of passengers would be proportionately increased. Greater economy in fuel and water would mean a saving of time in replenishing bunkers and water tanks, and, what is even more important, there would be a considerable reduction of the bunker space with a proportionate increase in the cargo space, or of the accommodation for passengers, as the case might be. Moreover, the author of the paper argues that as no condensing machinery would be required, there would be a reduction in the engine-room floor space.

To the above considerations we may add that for naval service, a successful marine gas-engine plant would offer many advantages. In the first place, from the point of view of strategy and tactics, the elimination of smokestacks and the telltale smoke would be a most valuable feature. Moreover, the lessened air resistance of ships (and this applies with particular force to fast passenger steamers) due to the absence of smokestacks would add not a little to the speed. The fuel economy of a well-designed gas-producer plant would enable a warship to steam further on a given supply of coal than she could do with steam boilers. The most important element in the problem is that of getting rid of the by-products, and delivering a gas to the engines that is of the requisite purity and cleanliness. If the highest grade of fuels were at all times available, the problem of providing a gas-producer engine for transportation purposes, that is for locomotives, portable engines, and marine engines, might be considered as pretty well solved. Unfortunately, the bulk of the fuel that would have to be used is of an inferior quality, unsuitable for gas-producer engine work. When someone shall have designed a plant that can furnish satisfactory gas to its engines, no matter what quality of coal is offered for its consumption, the gas-producer engine will become the great prime mover of the world.

A contrast between the price of coal gas for lighting and power purposes as compared with this country and Great Britain, and incidentally the benefit bestowed upon the community at large by municipal control of this necessity, is afforded by the recently published 1903-4 annual report of the Corporation of Widnes. The price of gas in this district is 33 cents and 29 cents per 1,000 cubic feet respectively. The latter price is charged for gas acquired for motive purposes. Although low prices prevail, the quality of the illuminant is not reduced, as the standard is controlled by the government. Yet notwithstanding the above low prices, a profit for the year of $3,000 resulted. The total cost of manufacturing the gas was 22.2 cents per 1,000 cubic feet, so that if necessary the price to the consumer can still be further reduced to an appreciable degree. In London the gas can be obtained over a great area for the price of 50 cents per 1,000 cubic feet, although the supply is carried out by a private company. The reason of this low tariff is that the dividends payable to the shareholders are limited by the government, and the operations of the company are rigorously controlled by the authorities.

THE HEAVENS IN AUGUST.

BY HENRY NORRIS RUSSELL, PH.D.

The chief astronomical events of this month are two eclipses, one of the sun and one of the moon, both of which are visible in the United States.

The lunar eclipse comes first, on the night of the 14th. It is partial, only about one-third of the moon's diameter being immersed in the shadow. The moon enters the penumbra at 8.9 P. M. eastern standard time; that is, at this moment an observer stationed at the proper part of the moon would first see the sun begin to disappear behind the earth. But it will not be till some time later that the darkening of the moon's southern limb will be apparent to the eye. At 9.39 P. M. the moon enters the earth's shadow proper, from which all direct sunlight is excluded, and she continues to press further into it for an hour, and then gradually moves out of it again, leaving it altogether at 11.43, and getting clear of the penumbra at 1.12 A. M.

This eclipse is therefore very conveniently observable in one part of the world, but little information of scientific value can be anticipated from it, thanks to the fact that the earth's atmosphere prevents the edge of its shadow from being sharply defined, so that it is impossible to tell with any degree of accuracy when it reaches any given spot on the moon.

Far more important is the solar eclipse on the 30th, which is one of the most interesting ones for many years. It is a total eclipse, of pretty long duration, and the line of central eclipse passes through several regions which are conveniently accessible for observing parties.

The eclipse is total at sunrise in Manitoba, just north of the United States boundary. Thence the shadow sweeps eastward across Canada, north of the settled districts, and comes out on the Labrador coast. It turns somewhat to the southward as it crosses the Atlantic, and reaches land again on the Spanish coast near Cape Finisterre. Crossing Spain, the shadow traverses the Mediterranean, passes near Tunis, enters the African desert, passes over the Nile near Assouan, and finally bids farewell to the earth somewhere in Arabia, less than three hours after it began in Canada. The duration of the total phase is greatest in Spain, where it is about 3¾ minutes, while it is about 2½ minutes in Labrador, and a little less than three minutes in Egypt.

Several parties of astronomers are going to Labrador, and many more to stations in Spain and Algeria, so that a goodly store of observations may be expected if only the weather behaves as well as it did in 1900, when the track of the shadow on the European side of the ocean was almost the same as at present.

Weather permitting, a great deal of spectroscopic and other information about the sun's surroundings will undoubtedly be obtained. Perhaps the most interesting observations from an amateur's standpoint are those that will be made in the search for a possible small planet nearer the sun than Mercury, by photographing the whole region of the sky near the eclipsed sun. This has been done at several recent eclipses, without result, only known stars being found on the plates; but the brilliant success of photographic methods in finding new satellites makes one feel that the search for an intra-Mercurial planet ought to be continued a little longer.

THE HEAVENS.

The finest constellations visible at this season lie near the Milky Way. We may begin with Lyra, whose brightest star, Vega, is almost overhead at 9 o'clock on an August evening. This splendid white star disputes with Arcturus and Capella the claim to be the brightest in the northern hemisphere of the sky. In fact, the order in which different observers would rank these three stars is different, not because the stars themselves vary in brightness, but because they are of very different colors, and some people have eyes more sensitive to one color than to another. When we come to consider the distances of the three stars, and their actual brightness, it appears that Vega and Capella, which are almost equally distant from us, are each about one hundred times as bright as the sun, while Arcturus, which is much more remote, is ten times as bright as either of the two.

Vega serves as a pointer to several interesting objects. Close to it on the northeast is a faint star, which can be seen to be double with the naked eye by a few people with keen eyesight, or by ordinary mortals with an opera-glass. Each of the two components is a fine telescopic double. Southeast of Vega, at a little greater distance, is a pair of third-magnitude stars, of which the western one is the remarkable variable Beta Lyræ, which changes more than a magnitude in brightness with great regularity in a period of about twelve days. The line of these two stars, carried eastward, points to Beta Cygni, a very fine double star in the Milky Way, well seen with a small telescope.

The rest of Cygnus lies to the northward, and contains several bright stars. The Milky Way in this neighborhood shows singular differences in brightness, with a number of dark patches, some of which look almost like clouds obscuring it. They are probably really gaps between the "star clouds," which send us most of the diffused light of this region, though they consist of very faint stars.

South of Cygnus is Aquila, with the bright star Altair lying between two fainter ones. Below this again is Sagittarius, with the little Milk Dipper, and farther west is Scorpio, now seen at its best.

Arcturus is the most conspicuous object in the western sky. The constellations Corona and Hercules lie between it and Lyra, Ophiucus and Serpens are between it and Scorpio, and Libra and Virgo are below it, the latter setting. Mars, which is in Libra, is the most prominent object in the southwest, and Saturn balances it in a similar situation in the southeast.

The great square of Pegasus is about an hour high in the east. Perseus and Andromeda are on the horizon north of it, and Cassiopeia above them. Draco and Ursa Minor are above the pole, and Ursa Major is to the left of it.

THE PLANETS.

Mercury is evening star until the 29th, when he becomes a morning star. He is best visible during the first week of the month, when he sets about an hour later than the sun, and can be seen in the twilight, almost exactly due west.

Venus is morning star in Gemini, and is unusually prominent, rising about 2 A. M. and being still very bright, though past her maximum. Mars is in Libra, and sets about 11 P. M. in the middle of the month. On the 26th he is in quadrature with the sun, and comes to the meridian at 6 P. M.

Jupiter is morning star in Taurus, almost exactly opposite to Mars, and rises at about the time that the latter sets. He is in quadrature on the 28th, but being west of the sun, he crosses the meridian six hours before him, instead of six hours after, as Mars does.

Saturn is in opposition on the 23d, and is visible all night. He is in Aquarius still pretty far south, but better placed for observation than he has been for several years. His rings are seen more nearly edgewise than has been the case for some time, and the orbits of his satellites are also apparently more elongated.

Titan, the brightest of the satellites, which can be seen with a small telescope, is west of the planet on the 3d, north on the 7th, east on the 11th, and so on, his period being 16 days. When he is north or south of the planet, his apparent distance is about equal to the diameter of the rings; but when east or west of it, it is about five times as great.

Uranus is in Sagittarius, and comes to the meridian at 8:30 P. M. in the middle of the month. Neptune is in Gemini, and crosses the meridian about 3 A. M.

THE MOON.

First quarter occurs at 5 P. M. on the 7th, full moon at 10 P. M. on the 14th (during the eclipse), last quarter at 1 A. M. on the 23d, and new moon at 8 A. M. on the 30th—again during an eclipse. The moon is nearest us on the 4th, farthest off on the 20th, and nearest once more on September 1. She is in conjunction with Mercury on the 2d, Mars on the 8th, Saturn on the 15th, Jupiter on the 23d, Venus on the 27th, and Mercury again on the 30th.

Cambridge, July 10, 1905.

A NEW KIND OF FIREPROOF THEATER.

Mr. Mausshardt, a German inventor, has recently made an attempt, successful it seems, to permit spectators to escape quickly from a theater in the case of fire. In fact, his project aims at emptying the theater within thirty seconds from pit to gallery, no matter whether it contains twenty or two thousand visitors.

When it is considered that the problem of moving bodily whole houses has been solved both in America and more recently in Europe, the task of conveying into the open the whole pit, including all its occupants, should not seem to be impracticable. In fact, Mr. Mausshardt places the whole pit, including the boxes situated on the same floor, and the partition walls of the lateral corridors, on rollers running over rails extending for a suitable distance in front of the theater. In the case of fire, the whole pit, including any rooms on the same floor, is moved into the open quite independently of any individual attempts to gain the open air through the corridors.

As regards the other part of the problem, namely, to convey the spectators in the balconies in the same short interval of time into the open, and to put them down on the street, this has been ingeniously connected with the first part of the rescuing problem. Each balcony has a number of window doors opening toward the street. Although closed during the performance, these doors are opened in case of emergency, either automatically all at a time or else singly by hand in case of a breakdown of the mechanism. Any one of these doors opens on a gallery, the galleries of each balcony being suspended by hinges from heavy outriggers, which act as powerful single-armed levers and which turn round pivots beneath the first balcony. When lowered, all the outriggers and the three suspended galleries will be moved sidewise, coming down outwardly on the street. The outriggers are fixed by their upper ends to wire ropes running over a pulley on the roof through the lateral walls into the ground floor, where they are wound up on rollers, fixed rigidly to the side walls. As the outriggers descend, a transverse shaft is actuated through a conical toothed gearing, and the racks fitted beneath the pit, and along with these the pit itself, which runs on rails, are set rolling. The exceedingly simple gearing is so calculated that at the very moment the outrigger galleries touch the street, the whole pit has been removed from the theater building. The entire apparatus has been so designed as to be operated from an inclosed cabin, after a signal has been received from the fire station of the theater.

There is, however, the possibility of some persons being left in the balconies after the rescuing has been performed. Now, these will be able to escape over stationary running galleries fitted outside to the building, the more easily as by far the majority of spectators have doubtless left the theater, so that there is no possibility of a crowd.

A model theater has been constructed by the inventor according to the plans of the Karlsruhe Court Theater, and a real theater on this ingenious system may soon be constructed.

SCIENCE NOTES.

One century has elapsed since Theodore de Saussure published his remarkable investigations relating to the nutrition of plants and to the influences upon plants of certain well-known physical forces. Although preceded by the publications of Duhamel, Hales, Ingenhouss, and Senebier, as well as by those in a somewhat different line, by Konrad Sprengel and others, we may look upon the work of De Saussure as a wonderful production for his time and as strikingly indicative of the status of plant physiological problems a century ago. His paper may be regarded in a sense as the original charter of plant physiology.

Prof. Albert M. Reese, of the Syracuse University, has gone to Florida, under the auspices of the Smithsonian Institution, to collect eggs of the alligator with which to work out its embryology; subsequently he will spend some time at the biological laboratory of the Carnegie Institution of the Dry Tortugas, developing his find of this crocodilian species. The alligator cannot long escape practical extermination. Already they are becoming scarce and the price of hides has gone up enormously in the last few years. The alligator is characteristic of the austroriparian region, ranging from North Carolina to the Rio Grande of Texas. It has never been seen in the Mississippi River north of Rodney, Miss., which is about latitude 32. Twenty-five years ago this reptile existed in great abundance in its range, but as alligator leather became fashionable about that time the demand thus created has reduced the supply by at least 98 per cent. It is said that a person may travel now from Jacksonville to Miami, Fla., without seeing a single alligator. It is estimated that 2,500,000 alligators were killed in Florida from 1880 to 1894.

In no country in the world do insects impose a heavier tax on farm products than in the United States. The losses resulting from the depredations of insects on all the plant products of the soil, both in their growing and in their stored state, together with those on live stock, exceed the entire expenditures of the national government, including the pension roll and the maintenance of the army and the navy. Enormous as is the total value of all farm products in this country, it would be very much greater were it not for the work of these injurious insects. The statistics of agricultural products for the year 1889, of the Twelfth Census, and for subsequent years, gathered by the Bureau of Statistics of this department, indicate an annual value of all the products of the farm of about $5,000,000,000. To one familiar with the work of the important insect pests of the different agricultural products entering into this total it is comparatively easy to approximate the probable shrinkage due to insects. The detailed consideration of such shrinkages which follow indicates that they will rarely fall below 10 per cent, and in years of excessive insect damage may amount to 50 per cent or even more of the important staple products of the farm. An annual shrinkage of 10 per cent is a low estimate, which is more often exceeded than fallen below, and indicates, at current farm prices, a money loss of $500,000,000—the minimum yearly tax which insects lay on the products of the farm. This total comprises, however, only losses suffered by the growing and maturing crops and annually by live stock, and does not include two very considerable and legitimate items, namely, the loss occasioned by insect pests to farm products, chiefly cereals and forage crops, in storage, and to natural forests and forest products. As shown in the consideration of these two sources of loss presented below, at least $100,000,000 must be assigned to each, making a total annual tax chargeable to insects of $700,000,000.

TELEPHONES ON EVERY STREET CORNER.

BY GEORGE J. JONES.

The public pay station has proved one of the most profitable features of the telephone business, some of these installations in the more populous portions of the larger cities having done a business of $250 per month, which explains their very rapid introduction into every available place. It is hardly possible in the busier portions of a large city to get out of range of one of these public station signs; and while the instruments are generously scattered through the residential portions of the cities, they are not so convenient as the telephone people would like to make them.

It has been argued that were it possible to have these instruments more accessible in the residence portion of the cities, it would probably in a great measure break up the habit resorted to by some persons of making use of the instruments installed in the houses of their neighbors, which is not only an annoyance to the subscribers, but a loss of revenue to the company. With the view of remedying these evils, many suggestions have been made and investigated. The most promising scheme is one which has been tried in the city of Bridgeport, Conn., and is about to be extended to a number of larger cities. This provides for telephones on every street corner.

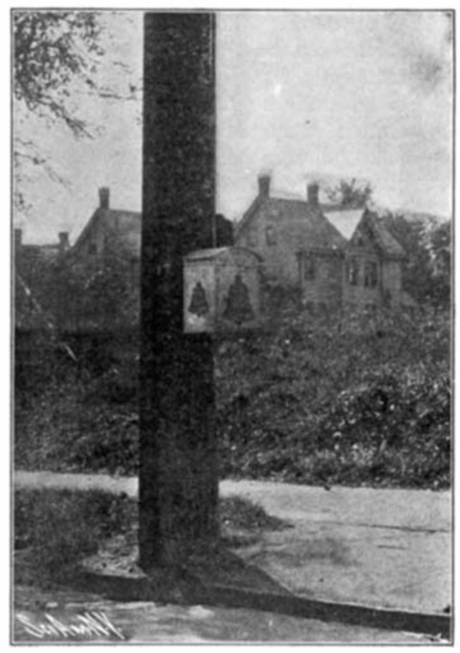
Views of these novel instruments are given herewith, and it will be seen that they are quite inconspicuous. They resemble the police and fire alarm boxes which are to be seen on the streets of many cities. These stations are all keyless, and upon opening the door, there will be found a standard installation of the gravity type. A directory is found hanging on the door, and the desired connection is brought about in the same manner as is customary with other instruments; the conversation having been finished and the receiver hung up, the door, being also of the gravity type, closes itself.

The boxes containing these equipments are sometimes mounted on pillars, and again merely secured to telegraph and telephone poles or even trees. In some cases the box will jointly occupy the same pillar with a mail box or fire-alarm outfit.

Where street privileges for the new telephone boxes have been declined by the municipal authorities, on the ground that there were already too many of these devices on the street, the objection has been met with the proposition to make these stations still more of the nature of public utilities by placing them at the service of the public for all municipal and emergency uses. It is possible to make use of these instruments instead of police and fire calls. An extremely convenient means of calling an ambulance or summoning police help is offered to any one, the company agreeing to transmit all messages of this character without requiring the customary formality of depositing the coin. These instruments are being introduced by Gray Telephone Pay Station, Hartford.

ONE OF THE BOXES OPEN.

TELEPHONE POST FOR CITY STREET.



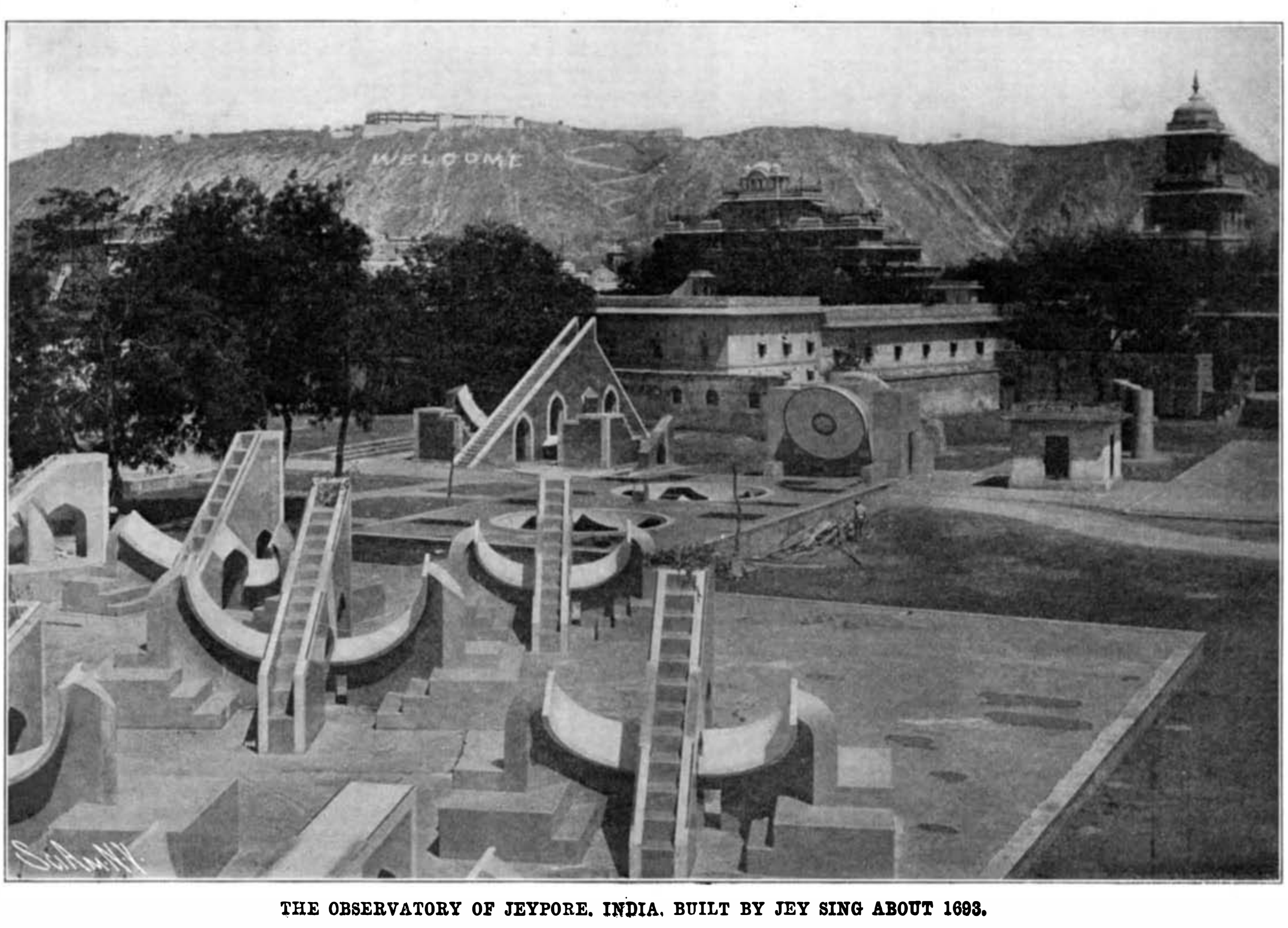
TELEPHONE FOR RURAL DISTRICTS.

A novel process of electric welding, developed by the Accumulatorenfabrik, Ltd., of Berlin, is based in its working on the heat evolved by an electric arc formed between the working piece and a carbon electrode at the place the weld is to be made. The carbon is fixed to the holder, and is readily shifted to any place in the neighborhood of the weld. An inconvenience with electric welding processes is the current shocks unavoidable in operation, but remediable perhaps successfully by using a relatively small current generator in connection with a storage battery connected in parallel. Even in case a dynamo serving at the same time for other purposes is used, this storage battery will prove efficient in avoiding any heavy fluctuations in pressure. The great amount of heat supplied to the working piece by the electric arc causes this as well as the metal to be welded to melt at the point of contact, thus insuring a rather intimate juncture of the two. The process is continued under a continuous supply of welding material, until the joint or the aperture to be welded is filled in entirely. Owing to the heat being partly carried away by the metal, there is no risk of the weld becoming superheated. The size and intensity of the arc are readily controlled, both being reduced gradually after the weld is completed, so that the material is allowed to cool down slowly, avoiding any stress. It is claimed for this process of electric welding that it affords a cheap and simple means of causing any flaws and other defects of castings, as well as cracks, to disappear. In connection with large heavy castings it affords the possibility rapidly and cheaply to repair smaller damages which otherwise would require the whole piece to be rejected. This is the case, for instance, with broken teeth of toothed wheels. Outside of cast iron, wrought iron and nickel or Siemens-Martin steel can be treated on the above process, applying pieces of the alloy in question. In connection with railway and tramway construction this welding method will, however, be used to especial advantage to connect the rail joints. The outfit used by the Accumulatorenfabrik comprises two cars, one of which contains the storage battery, while in the other there is installed a transformer to reduce to 60 volts the pressure of the direct current derived from the trolley wires.

THE PRIMITIVE OBSERVATORY OF JEYPORE.

Jeypore is the pleasant, healthy capital of one of the most prosperous independent states of Rajputana, India, and is a very busy and important commercial town, with large banks and other trading establishments. It is a center of native manufactures, especially those of many kinds of jewelry and of colored printed cloths and muslins. The enameled work done here is the best in India, and the cutting and setting of garnets and other stones found in the state is a large branch of industry. The crowded streets and bazars are most lively and picturesque. It is laid out in rectangular blocks, and is divided by cross streets into six equal portions. The main streets are 111 feet wide and are paved, and the city is lighted by gas. The Maharaja's palace occupies the center of the city, which has a population of about 143,000.

In Jeypore is the famous Jautra or Observatory, the largest of the five built by the celebrated royal astronomer, Jey Sing, the founder of Jeypore, who succeeded the Rajas of Amber in 1693. Chosen by Muhammad Shah to reform the calendar, his astronomical observations were formulated in tables which corrected those of De la Hire. He built five observatories—at Delhi, Benares, Muttra, Ujjain, and Jeypore. The observatory at Jeypore is the largest of the five. It is not under cover, but is an open courtyard full of curious and fantastic instruments invented and designed by him. They have been allowed to go out of repair, and many of them are now quite useless, it being impossible even to guess what purpose they served in the wonderfully accurate calculations and observations of their inventor; but the dial, gnomons, quadrants, etc., still remain of great interest to astronomers, and the Observatory at Jeypore is one of the places which is always visited by tourists.



THE OBSERVATORY OF JEYPORE, INDIA, BUILT BY JEY SING ABOUT 1693.

England the Pioneer of the Iron Bridge.

England is considered the pioneer country of the iron bridge, the first one, consisting of a nearly semicircular cast-iron arch, having been built in 1776-79. In 1786, Thomas Paine, the well-known author, designed and made a model of a segmental arch. This model was set up at Franklin's house in Philadelphia, whence it was taken to the State House, and, eventually, exhibited at the Academy of Sciences, Paris. Paine had an experimental cast-iron bridge built in England in 1790, and Rowland Burdon, in 1793 to 1796, built the bridge at Wearmouth of 240 feet clear span, after this model, which formed the basis of many cast-iron bridges built thereafter, and became the prototype of the modern steel arch. Paine's device was also the basis of the design of the Market Street Bridge and the first Fairmount Bridge, in Philadelphia, both being wooden arches. The former was completed in 1800, and the latter in 1812.

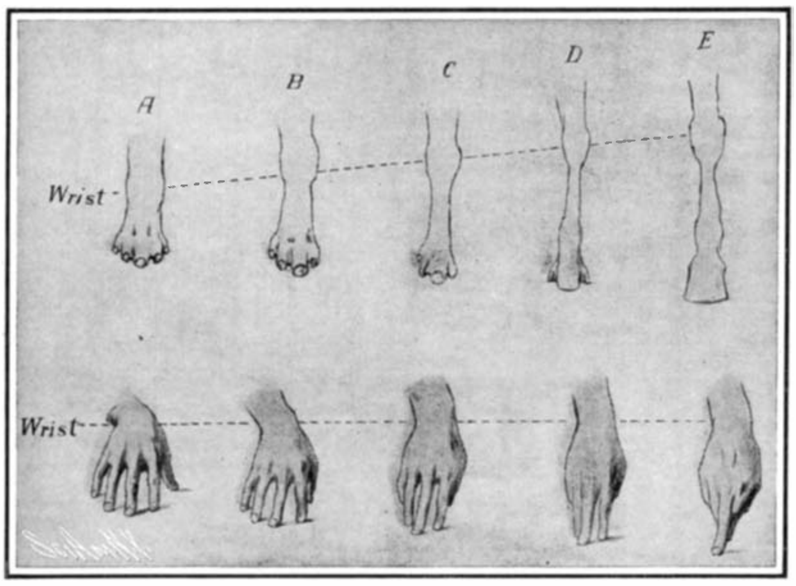
THE EVOLUTION OF THE HORSE.

At the American Museum of Natural History, Prof. Henry Fairfield Osborn recently gave six lectures under the auspices of the Trustees of Columbia University, entitled "The Jesup Lectures on the Evolution of the Horse." The lectures were illustrated, and covered first the recent and past researches of Prof. Osborn and his assistants (especially Mr. J. W. Gidley) and of other investigators on the fossil horses of America and Europe; second, the mass of writings by American and European zoologists upon the origin and evolution, relationships, structure, and habits of the breeds of domesticated and wild horses and of their near relatives, the asses and zebras. The following is an abstract of the lectures covering the first series of topics mentioned: The various races of the horse family furnish a beautiful example of adaptation, or the adjustment of the organism to its surroundings. In every animal of to-day the remnants of adaptations belonging to the remote past are mingled with adaptations to the present, and many characters of the domestic horse may be regarded as inherited adaptations of remote antiquity. Thus the habit of carrying the head high is a reminder of the time when the wild stallion at the head of the herd had to be always on the watch for foes; the sudden shying is an instinctive memory of the days when a quick jump to one side might save a horse from the sudden spring of a beast of prey; while bucking is a device for shaking an enemy off the back. Again, the usefulness of the horse for cavalry exercises depends upon his having inherited an instinct for acting in concert with his fellows.

The several parts and habits of a horse are also adjusted to each other, and these natural adjustments were what first made the horse valuable to man. Thus the horse is a quadruped, seeking safety and food by its speed and traveling power; it is also a "soliped," with stilt-like legs, walking on the tips of its single toes; and being a grazer and browser, its neck must be long enough to bring the lips to the ground. As a traveler it has acquired varied limb action and gaits, and also varied experiences, which have served to increase its resourcefulness and intelligence. Not being defended by horns or tusks, it uses its hoofs collectively as a weapon, which is particularly powerful and effective, the young being frequently defended from wolves by a ring of desperate hoofs. Since the chief enemies of the horse are the larger carnivores, it has developed quickness of sense and movement, and the young must be able to run with the herd at birth.

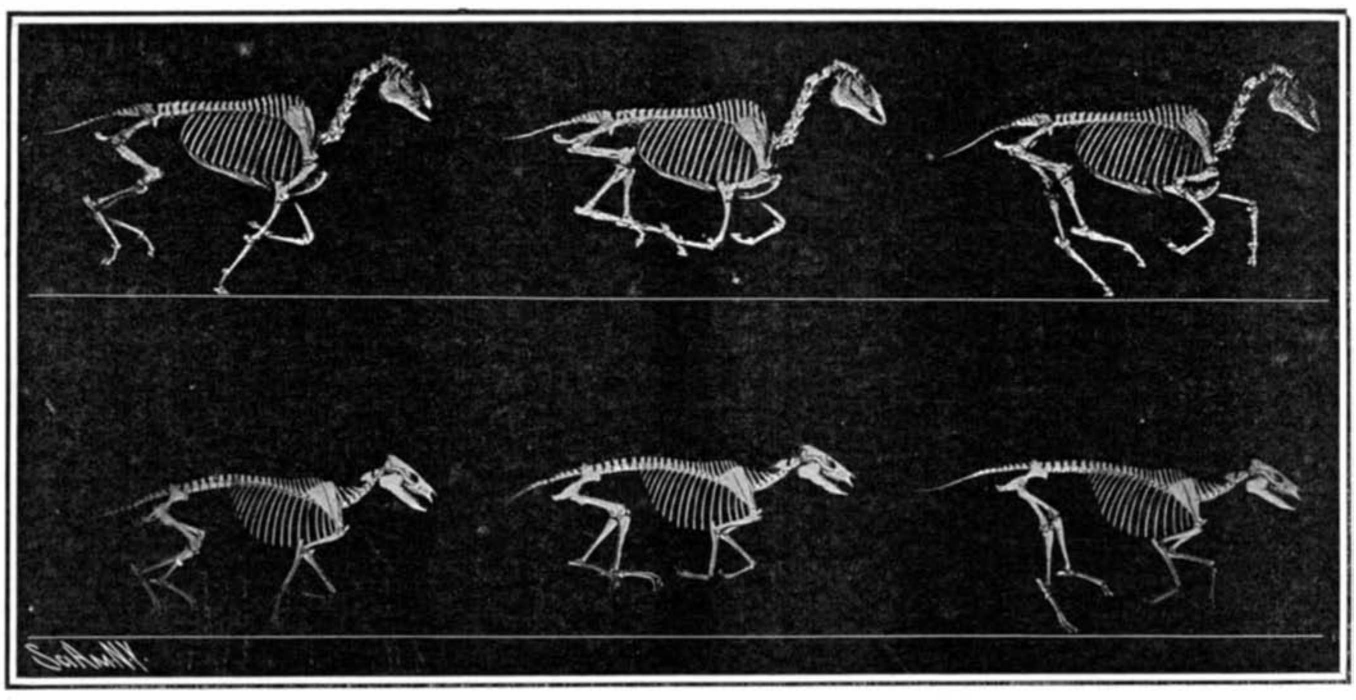
It is true that the horse is a complex "machine"; but it is more. No mere machine is self-perpetuating, no machine becomes perfected through long-continued use.

One of our photographs represents a beautifully mounted group consisting of the skeleton of a horse rearing and of a man, recently placed on exhibition in the American Museum. The picture shows that the bones of man and horse are strictly comparable, but man has retained more of the primitive or generalized features common to all mammals, the horse being far more specialized in the structure of its limbs and of its grinding teeth. The special structure and motions of the limbs are elucidated by the accompanying photographs of rearing and leaping horses. Figures were used by Prof. Osborn showing sections of the limbs, the various types of joints, the action of the muscles and tendons, of the ligaments and of the patella or knee cap. The several parts of the limb in their capacity of levers must also be considered. The rate of oscillation of the upper arm and thigh bones when acting like a pendulum has been increased by the shortening of these bones, and they have become drawn up among the muscles. For purposes of locomotion, the movements of the horse's limbs are principally fore and aft, the muscles for drawing the limbs across the body and for rotating the arms having been lost during the course of increasing specialization. The photographic and mechanical analyses of the motions of animals made by Muybridge, many of which have been published in early numbers of the SCIENTIFIC AMERICAN, show the varied gaits of the horse in comparison with those of the raccoon, tiger, elephant, camel; and the mechanical superiority of the trot over other gaits must be admitted. The traditional representations by artists of the trot and gallop are usually wrong. A draft horse in the act of pushing against the collar of the harness, and thus of drawing a heavy load, causes the backbone to curve somewhat at each thrust of either of the hind limbs, so as to bring the point of application of the force as near as possible to the midline of the body.



The Successive Stages in the Process of Rising on the Tip of the Middle Toe.

Most of the physical and mental traits of the horse are entirely useful. Usually each habit, each structure, must, as it were, pay its way, to give a definite return for the blood and food it receives from the organism as a whole. However, in human society there are individuals and institutions that have outgrown their usefulness, and although reduced in importance and destined to disappear ultimately, they still manage to "hang on." So too the horse retains traces of many former habits (e. g., a trace of the habit of brushing away the snow with its fore foot, so as to get at the grass underneath), and especially many vestiges in the skeleton. Among these may be mentioned the vestigial bony elements in the pelvis and shoulder girdle, in the wrist and ankle joints, and the famous "splint" bones back of the cannon bone, which are the vestiges of inner and outer toes. Sometimes organs which have entirely disappeared from the normal individual occur sporadically as "reversions." Thus the splints mentioned above very rarely appear as well-developed side toes, the foot of such a "freak" horse closely resembling that of one of the ancestral three-toed horses of the Tertiary period.


Skeletons of the Modern Horse (Above) and of the Small Four-Toed Horse (Below), Showing the Superiority in Length of Limb of Modern Horse.

THE EVOLUTION OF THE HORSE.

Many of the fossil skeletons now regarded as representing ancient equines were not recognized as such by their discoverers, on account of their very obvious differences from modern horses. For example, the great French naturalist Cuvier (1783-1844) who described the three-toed *Anchitherium*, recognized its horselike characters, but as he did not believe in the evolution or change of species, he naturally did not regard it as an ancestral equine. Other French naturalists described a number of other species with similar results. In England the great comparative anatomist Sir Richard Owen, had the good fortune in 1839, 1842, 1857, to discover in rocks of Eocene age the fossil remains of what is now regarded as one of the most ancient and primitive horses known (the term horse being used here in a very broad sense), namely, the little four-toed *Hyracotherium*. Darwin's great work on the "Origin of Species" (1859) set naturalists searching for "missing links" and ancestral forms, and so the French naturalist Gaudry in 1865 fully recognized the equine affinity of the three-toed fossil genus *Hipparion* of Greece and the ancestral character of the horses of the Upper Eocene period. Finally, Huxley predicted in 1870 that the horse and all other hoofed mammals would be traced back ultimately to a form with five toes on each foot, and both Kowelevsky and our compatriot Cope prophesied that this generalized form would have bunodont, or low-crowned, grinding teeth. Finally, the discoveries of Leidy, Cope, and Marsh (of Yale) in this country first made clear in a general way the successive steps of equine evolution, and furnished Darwin and Huxley with a celebrated instance of evolution as indicated by fossil history.

Evolutional changes involve either, (1) the remodeling of old parts, as in the evolution of the grinding teeth; (2) the reduction of certain parts and enlargement of others, as in the loss of inner and outer toes and the great enlargement of the middle toe; (3) the coalescence or fusion of parts, as in the case of certain wrist bones and the fusion of the two forearm bones (ulna and radius); (4) the addition of new parts, as for example the great increase in the total number of cusps in the premolar grinding teeth. Thus "evolution" does not imply a uniform advance of all organs. If some develop, others degenerate. In the feet, the outer and inner toes (like Peter) were "robbed to pay Paul" (the main middle toe). Sometimes we seem to have evidence that evolution has taken place in a definite or determinate direction, as if, for example, the final complex pattern of the horse's grinding teeth were the goal toward which the trend of evolution had been aimed from the first. In fact, as shown by a series of photographs, all the elements of the complex later teeth are present, as it were "in embryo," in the crown of the molars of the ancestral *Protorohippus*, the grinding teeth being low-crowned and their crowns with low tubercules, instead of the elaborately folded crests of later types. Hence, all the earliest hoofed animals retain this condition more or less fully, and among early horses the famous *Protorohippus*, the virtual founder of the horse dynasty, makes the nearest approach to it. A number of illustrations published some time ago in these columns represent the skeleton, the foot structure, teeth, and probable appearance in the flesh of this fascinating little creature, which was actually smaller than the head of one of its modern representatives. The *Protorohippus* had already lost by reduction the inner or first, and the outer or fifth toe in the hind foot, and most of the inner or first toe in the fore foot. This process of reduction was demonstrated to have gone on until in the final stage of evolution but one great toe, the middle of each foot, remained. The reason for this change is quite apparent. The horse family has made speed the keynote of its evolution; it had elected, as it were, to run instead of to hide, to seek for food over a wide area. One factor of speed is length of limb;

wherefore the "horse" rose up on its toes, and the toes began to elongate. The first effect of this was to lift the shorter toes, Nos. I and V, clear of the ground, and being no longer useful in supporting weight, they speedily dwindled and vanished. Meanwhile the middle digit had to bear more and more weight, and hence it grew larger. The process of getting up on tip-toes being continued, Nos. II and IV followed Nos. I and V, until finally only No. III, the middle toe, remained, with vestiges of I and V.

A Fireproof Theater of Armored Concrete.

A well-known German firm is building a miniature fireproof theater of armored concrete, which is specially intended for fire tests, and is to become a model theater where any safety devices which have so far been suggested against the danger of fire, as well as any preventions that might be proposed in future, will be demonstrated.

The theater is to be fitted with a stage of 7.5 meters breadth and 6 meters depth, separated by an iron curtain from an amphitheater 5.5 meters in breadth and 7 meters in depth. The stage consists of the resting place, the rolling floor, a working gallery to the right and another to the left, and an adjusting bridge. The latter parts are of iron, and are suspended by ties of the same material from the ceiling, which consists of massive Monier concrete. The amphitheater consists of a simple gallery with lateral issuing staircases leading into the open. Special rain attachments are to be provided.

In connection with the experiments contemplated, the outlets through which smoke of a fire may escape will be studied with especial care. Any combustible decorations exposed will be fitted as in actual operation. It is thought possible by these experiments to find out devices for rendering a stage fire ineffective to the amphitheater. If the gases are led away promptly and safely from the stage into the open air, and if sprinkling proves an efficient fire-extinguishing agent, an amphitheater of fireproof construction might be safe against any danger of fire. According to a report in Der Gesundheits-Ingenieur, it is intended to make fire tests before filled amphitheaters.

Accident to the Montgomery Aeroplane.

On July 18, in the presence of 2,000 persons who had gathered at the Santa Clara College grounds to see the flight of Prof. John J. Montgomery's aeroplane, the "Santa Clara," the machine collapsed when at the height of nearly half a mile and Aeronaut Daniel Maloney was hurled to the ground. The flying machine was shivered into fragments, and Maloney, who was picked up with a fractured skull, lived only an hour.

A balloon raised the aeroplane to a considerable height. When the fabric was but a speck in the sky, balloon and aeroplane slowly parted company. To the left the aeroplane slowly circled, cutting pretty figures. Maloney seemed to have perfect control of the machine.

Then, suddenly, the device refused to obey the guiding hand of the aeronaut, and with an abrupt circle it plunged quickly to the left and nearly overturned. Maloney could be seen struggling with the guide wires, but it was apparent that his efforts were futile. The machine fell swiftly earthward. One of the wings collapsed as the aeroplane gained added impetus and the mate snapped from its support and fluttered limp in the air. The front wings still remained outspread and checked to a slight degree the swiftness of the descent, but down with fatal impetus the aeroplane came through 2,000 feet of space.

The disaster was probably due to the guy rope catching one of the wings of the aeroplane as it was liberated. The machine has been fully described in these columns.

The Current Supplement.

The current Supplement, No. 1543, opens with a most thorough article on motor omnibuses in London, by the English correspondent of the Scientific American. The article excellently shows how automobile omnibuses are competing with English tramways and gives valuable data. The Cerebotani facsimile telegraph is described by Emile Guarini. Mr. Brysson Cunningham presents a most instructive article on concrete, giving much practical information. "An Island Prison on the Forth," is the title of an article which describes the picturesque Bass. The English correspondent of the Scientific American writes on a torsionmeter for recording the horse-power of steam turbines. Dr. Alfred Gradenwitz contributes a brief but interesting article on the use of bronze castings for naval purposes. Many years ago Prof. Henry Draper prepared a monograph on the construction of a silver glass telescope 15½ inches in diameter in aperture and its use in celestial photography. That monograph to this day is by far the best treatise of its kind ever written on the construction of a reflecting telescope. The Editor of the Supplement has deemed it advisable to republish this valuable monograph and accordingly the first installment will be found in the current issue.

A NEW INTERRUPTER.

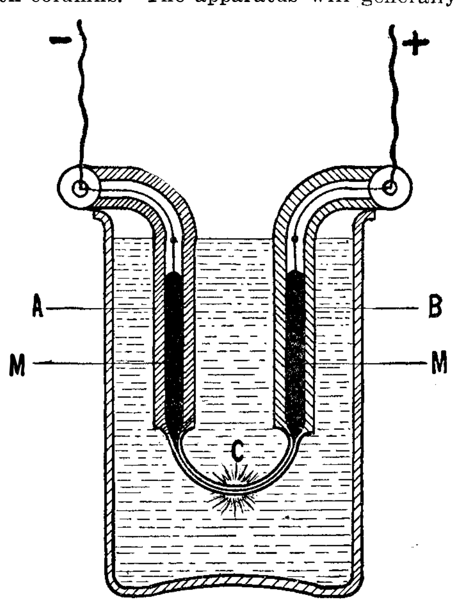
By Huck Gernsback.

Experimenting with different magnetic and electric interrupters, the idea occurred to me that it might be possible to construct an interrupter whose chief functions would be based upon the expansion and contraction of mercury, when heated, by passing a current through it.

After many fruitless experiments I succeeded in making such an interrupter, and the definite form that proved most satisfactory is explained in the following lines:

A barometric glass tube of about 15 centimeters length, with a central opening of 3 millimeters, is heated in an oxy-hydrogen flame and drawn into the shape, as shown in the accompanying drawing. This is by no means easy, as the tube, *C*, which represents the main part of the interrupter, must be so attenuated as to leave a capillary bore within, its minute diameter not surpassing ⅛ of a millimeter.

Heat the middle part of the tube over the flame by constantly rolling the ends between three fingers of each hand, till it is red hot and soft. Take the tube quickly out of the flame, and draw it straight out, till it is thin enough; then bend it into the right shape, and let it cool slowly. Of course, these manipulations have to be done quickly, because the glass will not remain soft very long in the open air, and it is nearly impossible to draw the capillary tube when the flame touches it. The tube has to be filled then with chemically-pure mercury, which is easily done by placing the end of the open column, *A*, in a receptacle containing the quicksilver. By drawing the air out of *B*, the mercury will quickly mount in *A*, then pass through *C*, and rise up in *B*. It is well to only half fill both columns. The apparatus will generally work



A NEW INTERRUPTER.

satisfactorily, when the whole arrangement can be placed in any desired position without the mercury flowing out of it. This is a sign that the capillary tube, *C*, is sufficiently attenuated.

Two thin platinum wires are introduced into *A* and *B* till they dip in the mercury. The apparatus is put into a vessel containing water, which serves to constantly cool *C*, which part would soon break in the open air. Connect the two wires with two small storage batteries, and the interrupter will start instantly. In the middle of *C* there will be a bright bluish-green spark, and a high-pitched tone will emanate from the interrupter, indicating that the interruptions are of high frequency.

I found that this interrupter works most satisfactorily with 4 to 6 volts; it will consume, when made according to directions, from ¼ to ½ ampere, and run as long as desired. By making the part, *C*, of a larger cross-section, the voltage may be higher and more current will be absorbed, but the interruptions will be very unsteady and irregular, and will very often give out entirely.

The instrument, I believe, cannot be used with high tension currents, as it is too delicate, but it will work satisfactorily in connection with small induction coils, for instance, although a condenser will be required.

The explanation as to how this interrupter works is as follows:

The instant the current is closed, the mercury at the smallest cross-section in *C* will become so heated that it commences to boil, and the force of the resulting bubbles, falling against each other, will be sufficient to make a momentary rupture in the thin mercury column. There will be a little shock, and the expanding quicksilver will rise in *A* and *B*. Of course, a vacuum will be created at the place where the rupture occurred; and as the tube is immersed in water, the mercury will stop boiling; it cools instantly, then contracts, and the atmospheric pressure, combined with the weight of the quicksilver columns in *A* and *B*, will help to bring the metal in contact again, after which the same play commences as described.

The Charcot Expedition.

An interesting lecture on Antarctic exploration was recently delivered before the British Royal Geographical Society by Dr. Jean Charcot. This explorer has only recently returned from an expedition which was organized and primarily financed by himself, and the lecturer related the results of his researches. Dr. Charcot limited his expedition to the survey of the northwest coast of the Palmer Archipelago (Hoseason, Liege, Brabant, and the Antwerp Islands); the exploration of the southwest entrance to the Gerlache Strait and of Graham Land, with a view to elucidating the Bismarck Strait, and to follow the coast as far as Alexander I. Land, so as to substantiate and further the labors of the Gerlache and Nordenskjold expeditions.

His vessel, the "Français," was of only 245 tons. The staff consisted of six unpaid officers and a crew of fourteen, all French except one Italian, an Alpine guide. Dr. Charcot himself was captain, doctor, and in charge of the bacteriological studies. The expedition left Buenos Ayres on December 23, 1903, reached Smith Island (South Shetlands) on February 1, 1904, and thence went on to Low Island. Coasting the northwest side of the Palmer Archipelago, they entered Briscoe Bay, and afterward stayed eleven days in Flanders Bay. Then, after erecting a cairn on Winche Island (this cairn was missed by the Argentine relief expedition, which therefore believed and reported that the "Français" and her crew were lost), they sailed on and reached Pitt Island on February 26, but were compelled by ice to return to Wandel Island, where they wintered. The ship was protected from ice brought in by the northeast gales, with cables across the mouth of the narrow haven. They erected a portable house, excavated storehouses, and set up shelters and instruments for magnetic observation, observation with quadrant and sextant, and so forth. The temperature varied much and suddenly; the lowest was —30.4 deg. F., but a rise from —22 deg. F. to 26.6 deg. F. in a few hours was not uncommon, and was always followed by violent gales from the northeast, which broke up the ice between Wandel and Hovgaard islands, and so prevented any move being made, in spite of many efforts. In December a channel was made by means of melinite and saws and picks, and the "Français" returned to Winche Island. Early in January they came in sight of the Briscoe Islands, and on January 11 saw Alexander I. Land rising very high on the southeast. The voyage was continued in great difficulty and danger in the hope of finding means to reach the land, on which several peaks hitherto unknown had already been descried. On January 14 the "Français" struck a submerged rock, and received damage which necessitated pumping incessantly all day and night, and this was maintained for weeks until the ship so far recovered as to be safe with only fifteen hours' pumping, in which condition she ultimately returned to Buenos Ayres. The new coast along which she was sailing was surveyed, drawn, and named after President Loubet, and the "Français" turned north again past the Briscoe Islands, the expedition completing its survey as it went, and finally reached Puerto Madryn on March 4.

Another Device for Preventing Seasickness.

An ingenious self-leveling sea bunk for vessels, the object of which is to overcome the discomfort to the passenger of *mal-de-mer*, has been devised by a London dentist. It has now been in successful operation upon one of the mail-boats plying across the English Channel. The device comprises a swinging cot with four cords passing from the corners to electric brakes, which automatically check any attempt of the cot to depart from its position. While the cot remains level, the cords are free to pass on and off the pulleys on the brakes. The slightest loss of horizontality of the cot causes mercury in four tubes to fall in some of them and rise in others, and so complete the electric current to the particular brake required to be put in operation to check the further loss of horizontality. The loss of level from the variation of the position taken by the passenger is automatically compensated; water being practically the same specific gravity as the human body, a heavy man will press more water to the foot of a specially-designed water bed than a light weight, as also from side to side.

The Dangers of Cheap Leather.

The danger attending the use and wearing of adulterated leather is not perhaps fully realized. A large amount of the cheap leather is weighted with glucose and barium, especially the latter, so that when the weight test is applied, such adulterated leather may pass as first-quality material. Leather so treated, however, has the peculiar quality of absorbing moisture freely and retaining it to an extreme degree. The result is that a boot made of this chemically-treated material is in actuality never dry. Even in the driest weather the perspiration of the feet is sufficient to render the footwear dangerous, as such natural moisture acts upon the inner sole and collects there.

Correspondence.

Electrically-Propelled Gyroscope.

To the Editor of the SCIENTIFIC AMERICAN:

In your number of July 15, page 50, you speak of electrically-propelled gyroscopes as being quite new.

The late Mr. George M. Hopkins had an electrically-propelled gyroscope fifteen to twenty years ago. His work upon the gyroscope is described in the Encyclopædia Britannica, ninth edition, under gyroscope. The first edition of "Experimental Science" has the cuts and description of the electrically-propelled gyroscope, which I have seen operated many times. When the writer was president of the Department of Physics, Brooklyn Institute, Mr. Hopkins demonstrated his numerous gyroscopes before the department. A short time afterward the Institute building was damaged by fire, and these valuable instruments were totally destroyed. It was a great loss.

It is due to the memory of this most skillful experimenter that his credit in this matter should be maintained. W. C. PECKHAM.

Stamford, N. Y., July 14, 1905.

The Rolling Motion of a Wheel.

To the Editor of the SCIENTIFIC AMERICAN:

I was much interested in reading the article "The Motion of a Rolling Wheel," by G. F. Starbuck, in the June 24 number of the SCIENTIFIC AMERICAN.

A very simple way to understand the motion of a rolling wheel is as follows: Motion of a body is relative and can only be judged by comparison with another body. In the case of a rolling wheel there are two distinct motions, the rotary motion of the wheel about its axis, and the horizontal motion of the wheel as a whole.

To understand it clearly lose sight for a moment of the idea that the rail is stationary and the wheel moving, as we only consider the rail stationary by comparison with surrounding objects, and imagine the wheel as revolving in space and the rail (or ground) traveling in a straight line at the same speed as a point on the rim of the wheel. A point on the rail touches the point on the rim of the wheel and for that instant there is no motion as regards these two points for they are both traveling at the same speed.

Halifax, N. S., July 1, 1905. E. G. STAYNER.

Wireless Telegraphy on Trains.

To the Editor of the SCIENTIFIC AMERICAN:

Wireless telegraphy on trains would act as a preventive of accidents in a great many cases. It could be used as an extra precaution in addition to the block system. On single-track roads, in case a train had disregarded its meeting point, or orders, and had gotten by the last telegraph office, the dispatcher could catch it with the wireless. Railroad officials, by having a wireless set in their private cars, could keep in touch with affairs while traveling over the road. In foggy or stormy weather, trains could keep informed as to other trains ahead or behind, thus avoiding rear-end collisions. It would also prove invaluable on electric lines, especially single-track, whereby meeting points of cars could be arranged.

Every main-line switch should be protected by interlocking, and handled from a tower or connected with an electric signal located some distance away from it; and in case of its being open, or tampered with in any way, this signal would show "danger," thus avoiding any such disaster as recently occurred to the Twentieth Century Limited. In case of a signal showing danger, trains could approach with caution, and set things to rights. This same signal would also be used to give warning, in case of broken rails or misplaced fishplates. By having these signals located at certain distances apart, a whole railroad could be guarded against wrecks, except unavoidable accidents, which are liable to occur at any time, in spite of man or mechanism. F. H. SIDNEY.

Boston, Mass., June 29, 1905.

A Life-Saving Coat.

A London tailor has invented a new life-saving coat and gaiters, with which it is possible for a person clothed therein to maintain an upright position when immersed in the water, even if not possessing any knowledge of swimming. The coat resembles in appearance an ordinary pilot coat; but it is fitted with an air belt; which is inflated with air through a tube. The gaiters each weigh two pounds, and are fitted with two brass wings or blades fastened to the back of the heel. As the wearer moves his feet in the water these wings open and shut, and not only propel the wearer along like oars, but enable him to maintain an upright position from the waist upward in the water. A practical demonstration of the utility of the invention was recently undertaken in the River Thames by the inventor, and its efficiency and life-saving qualities clearly shown, even when moving against the tide.

Electricity on Swedish Trunk Lines.

A single-phase electric locomotive has been designed for the Swedish government railroads, and experiments are to be carried out therewith, on the application of the electric power to the trunk railroads. Externally, there is no departure from the design of the conventional electric locomotive. Current is drawn from an overhead conductor, and is designed to work at a line pressure of 18,000 volts as a maximum, though arrangements are made to use several lower pressures, the lowest being 3,000 volts. The locomotive carries an oil-cooled auto-transformer to reduce the pressure for the motors, and an oil circuit breaker. The electro-pneumatic control system is used, a compressor driven by a single-phase motor supplying air for all auxiliary power purposes, such as switching, braking, sanding, etc. The locomotive and equipment weigh 25 tons, and are carried on four 41-inch wheels. Each pair of these is driven by a 150-brake-horse-power single-phase motor at 25 periods with a gear reduction of 18 to 70. The locomotive will handle a train at 40 miles an hour, and has been built by the British Westinghouse Company, Limited.

FIVE THOUSAND DEGREES OF HEAT.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

It has been rightly said that civilization began when man first discovered the use of fire. This is symbolized by the legend of Prometheus stealing the fire from heaven and thus conferring untold benefits upon mortals. Nearly all the arts are indebted to the use of fire, and in our modern times we obtain continually increasing sources of heat, such as are necessary for the progress of science and industry. The higher the heat we are able to obtain, the greater is the field for new discoveries and processes by which our horizon is widened.

This is exemplified in a striking way by the modern invention of the electric furnace. Here we reach the top of the scale, and many are the advantages we obtain from such a powerful source of heat. The blast furnace uses a heat of 2,400 deg. F. to produce the iron from the ore and send it out in a melted stream, while the Bessemer converter, the next step in the process, brings us 400 or 500 deg. higher. Then comes the oxy-hydrogen blowpipe. By the combustion of hydrogen and oxygen we obtain a small blue flame which gives us a heat of 3,600 deg., and is sufficient to melt platinum and other refractory metals. Here we approach the temperatures which were employed in the interior of the earth to form many of the minerals, among others the different gems. With the heat of the oxy hydrogen blowpipe we are now enabled to imitate some of these processes. One of the most remarkable of these results is the formation of the ruby, which is only alumina or the material of ordinary clay, crystallized at an intense heat. The ruby is formed by sifting powdered alumina into the gas stream which goes to the flame, and there it is melted and it deposits beyond the flame in a transparent mass. In this way rubies of large size weighing 10 or 15 carats can now be formed, and in quality and color they equal and even surpass the rubies found in the earth.

Now that we have succeeded in obtaining the ruby by artificial means, it is only natural that we should expect to go farther in the scale of heat and produce other gems that have been formed in early times by the intense heat of the earth's interior. We know that the diamond is after all only crystallized carbon, and in fact it has no essential difference in composition form ordinary charcoal. Both are nearly pure carbon, but the diamond has been brought to the crystalline form under the powerful forces and high heat which prevail in the interior of the globe, while charcoal is formed under the ordinary conditions of the earth's surface. There is thus an essential difference in the way these two forms of carbon have been produced. We find that when we attempt to produce the diamond we come face to face with great difficulties, seeing that we are obliged to imitate to some extent the immense forces which were in operation in the earth's interior and so reproduce nature's process if we wish to obtain the same result. How to imitate this process was the question, and for a long time scientists were even uncertain as to just how the diamond had been formed originally. We know that it was crystallized from carbon which was kept at a very high heat, but as it has never been proved that carbon has been melted at such a heat, the matter seemed problematic.

It was the eminent French chemist, Prof. Henri Moissan, who found the first clue to the mystery and on following the matter up he was finally able to imitate the process of nature and actually form the diamond in minute crystals, and we may hope in the future to produce larger diamonds which will be as clear and brilliant as those we find in the earth. The way Prof. Moissan studied the formation of the different kinds of carbon and the wonderful results he obtained with the electric furnace form an interesting chapter in the history of science. In fact, the electric furnace soon began to prove of great value in forming all kinds of new compounds which we had never been able to obtain before. We will speak principally of the diamond, as it is the most interesting of the bodies which the electric furnace has produced. M. Moissan was led to his discovery by observing a specimen of meteorite from Diablo Cañon, Arizona. A large block cut from it had been sent to him at Paris. The mass was mainly composed of iron, and upon analyzing it he found that it contained many small black diamonds and some transparent diamonds of crystalline form. The way in which Nature formed the diamond seemed to be shown here in an unexpected manner. We are led to suppose that the carbon must have crystallized and separated from the mass of iron. The carbon was no doubt dissolved in the iron when in a melted state at a very high heat and on cooling the carbon took the crystalline form, just as any soluble salt may crystallize when the solution is cooled. Here the action is somewhat different, as it requires a high pressure to make the diamond crystallize. This pressure was no doubt obtained in a very natural way when the mass became solid, as we can imagine that when the outside was suddenly cooled the inside had to expand and was now at a very high pressure. Thus cooled, the mass deposited the diamond crystals as we find them. If we could reproduce the same conditions it might be possible to obtain the diamond, but how to proceed was the question. We must make the carbon dissolve in melted iron at a very intense heat, such as no doubt prevails in the interior of the earth or in the highly heated bodies from which the meteorites come.

The electric furnace was here called upon to give us the necessary heat. The electric arc is, in fact, one of the most powerful sources of heat that exists, and when the arc is produced on a large scale and confined in a narrow space we have a heat that cannot be surpassed, and we obtain, in fact, a heat of 5,000 degrees. Thus originated the electric furnace, which is now one of the most marvelous resources of modern science. Here we have electric force transformed directly into heat, and we no longer use heat obtained from chemical combustion as before. The modern electric furnace uses very simple means to obtain its wonderful effects. Two carbon rods, of two or three inches diameter, project into a cavity formed in a chalk block. The electric arc is formed in the center just over a carbon crucible. A cover of chalk a few inches thick is placed on the top and the arc is entirely confined, so that nearly all the heat is kept inside. It is a striking fact that owing to the non-conducting property of the chalk the operator can place his hand upon the top cover, and a piece of ice will remain on it for a long time without melting.

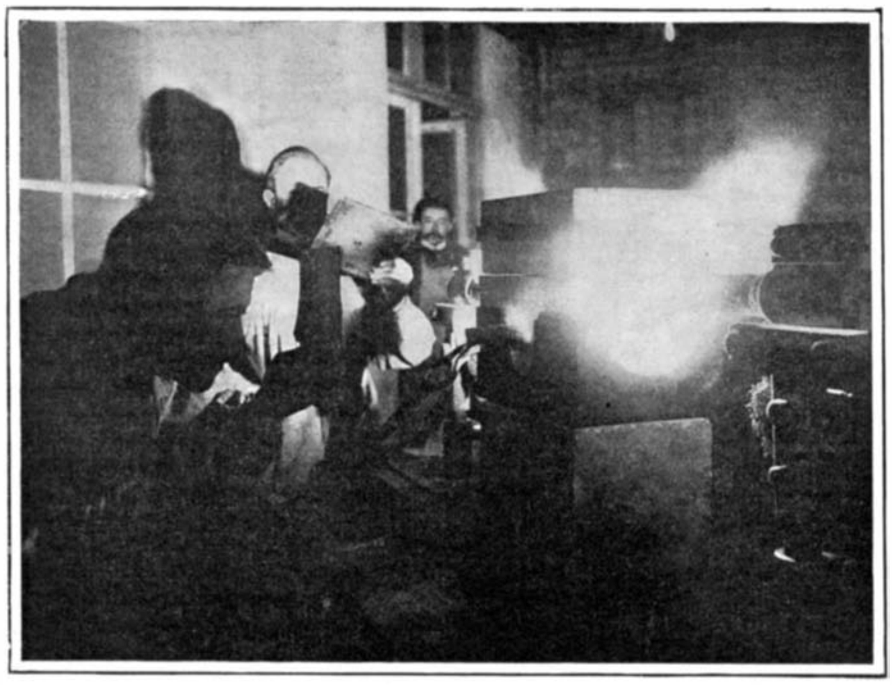
It is a striking spectacle to watch the electric furnace when in action. Long flames shoot out from either side through the openings, giving a blinding light accompanied by a loud hissing noise which the arc produces. The operators are obliged to wear glasses which are nearly black, so as to protect their eyes from the intense light while they watch the progress of the heating. In such a furnace we reach the extraordinary heat of 5,000 degrees, and at this point nearly everything can be melted. Even the chalk block fuses on the inside. A striking experiment is to boil silica or ordinary sand or flint in a carbon crucible. Not only does the sand melt and boil, but it is given off in the form of vapor. By using a perforated cover and placing a bell-jar over the furnace for an instant we see the vapors condense on the inside of the jar in fine powder. Almost all known matter is melted and volatilized at such a high heat. Here we have no less than 150 horse-power constantly transformed into heat. Naturally, to produce such a great force requires considerable expense; thus to run the electric furnace which is illustrated here costs about 80 cents a minute or $48 an hour. To run it all day long one would therefore have to pay some $500 or more.

Once in possession of the electric furnace, M. Moissan tried to reproduce the process which nature was supposed to have used to form the diamond. The essential part was to dissolve the carbon in iron which has been kept in fusion at 5,000 deg. At such a high heat iron dissolves a large amount of carbon. The next step is to cool the mass suddenly so as to form a solid crust, while the inside of the mass is still in the molten state. Then when the inside begins to cool it tries to expand, but is imprisoned in the outer layer. An immense pressure is the result, and in such case the carbon is expected to come out in the form of crystals. The process is a simple one, but of course requires great care in carrying it out. To the iron which is melted and kept at a white heat in the furnace we add the right amount of carbon in the form of small grains of charcoal. The cover is placed on the furnace and the carbon is soon dissolved. Then the furnace is opened and the operator seizes the crucible with a pair of tongs and plunges it quickly into a bucket of water. A brilliant display of fireworks is the result and sparks fly in all directions, accompanied by a loud hissing noise. There is no explosion, as was feared when first making the experiment, and there is really no danger in carrying it out. The best results are obtained when the mass is cooled very sud-

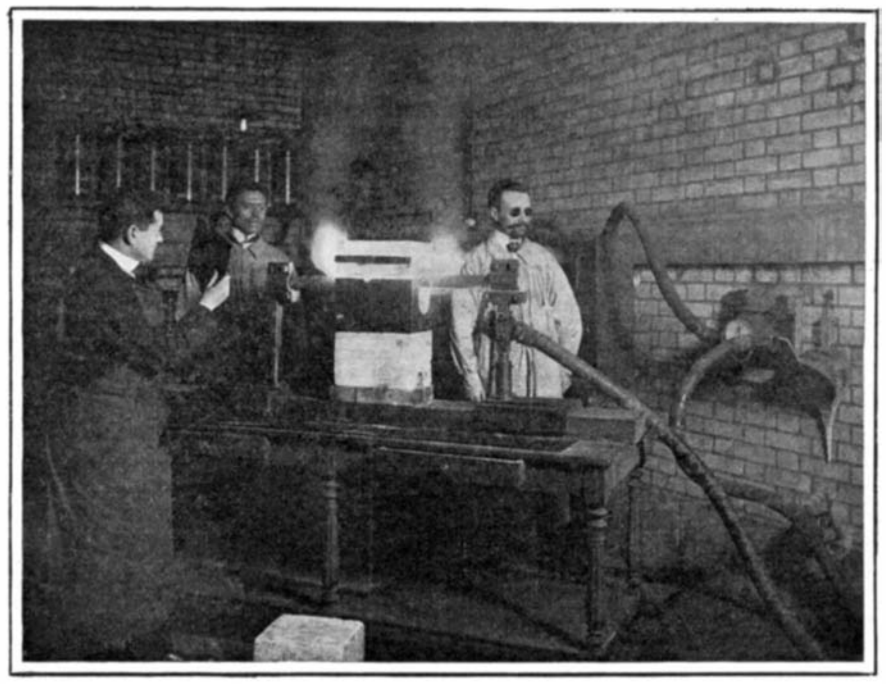
denly. It is found that a layer of gas forms around the crucible in the water, so that it forms a sort of cushion and keeps the heat from escaping quickly. A bath of melted lead was then used to cool the crucible. Cooling in melted metal may appear strange at first, but we must remember that the crucible is at 5,000 deg. while the lead is only at 606 deg. This forms a good contact and the heat is quickly carried off. After cooling, the metallic mass is treated with acids, which dissolve away all the iron and leave only the fine grains of carbon. These grains consist of black and transparent diamonds. As the clear diamonds are very dense, they can be separated from the others by placing in a certain liquid which allows the black diamonds to float, while the transparent crystals fall to the bottom. These crystals are found to be real diamonds, in spite of their microscopic size, and some means may be found in the future for obtaining still larger diamonds which will rival those produced by Nature in brilliancy. In fact, the diamond crystals are remarkably clear and bright, and on a small scale are as fine specimens as the large ones.

This remarkable result is only one of the benefits which we obtain from the high heat of the electric furnace. Chemistry is enriched with a whole series of new compounds, some of which are of great value in the arts. Different metals, such as manganese, chromium, and titanium, are now easily produced in large quantities. Before, it was difficult and costly to obtain such metals, and as they are of great importance in metallurgy, this is a step in advance. Then, we must remember that the modern industry of carbide of calcium and the acetylene gas which comes from it is due to the electric furnace.

It will be a long time before we have exhausted the continually increasing list of discoveries which are being daily obtained from the electric furnace. After that, we may begin to look for a source of higher heat, but for the present there is plenty to occupy us in this vast field of research. For our information and the accompanying illustrations we are indebted to Lectures pour Tous.



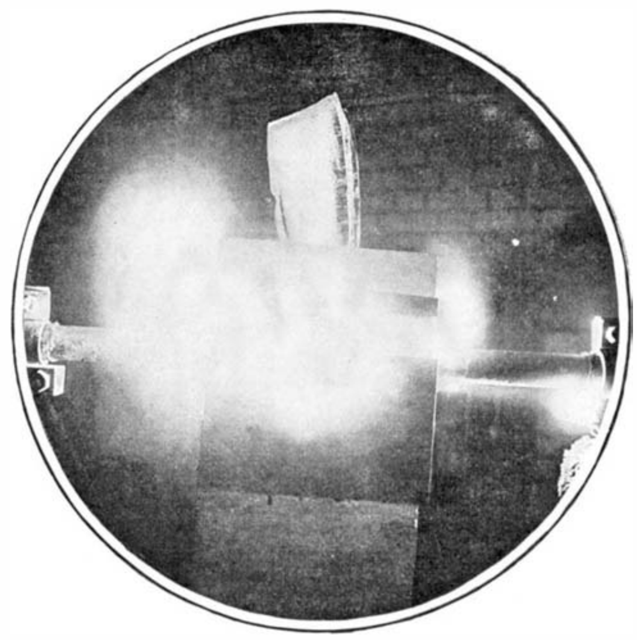
In This Experiment a Tube is Used Instead of a Crucible.



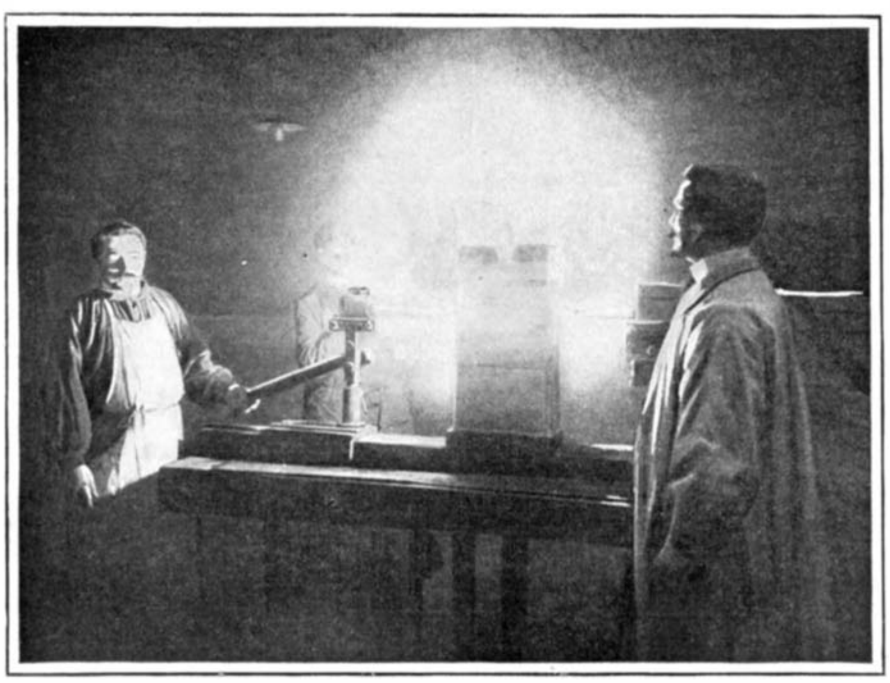
The Moissan Furnace in Operation. The Eyes Must be Shielded from the Arc.

The Hand Can be Held Without Danger Over the Furnace, Despite the 5,000 Degrees of Heat Within.

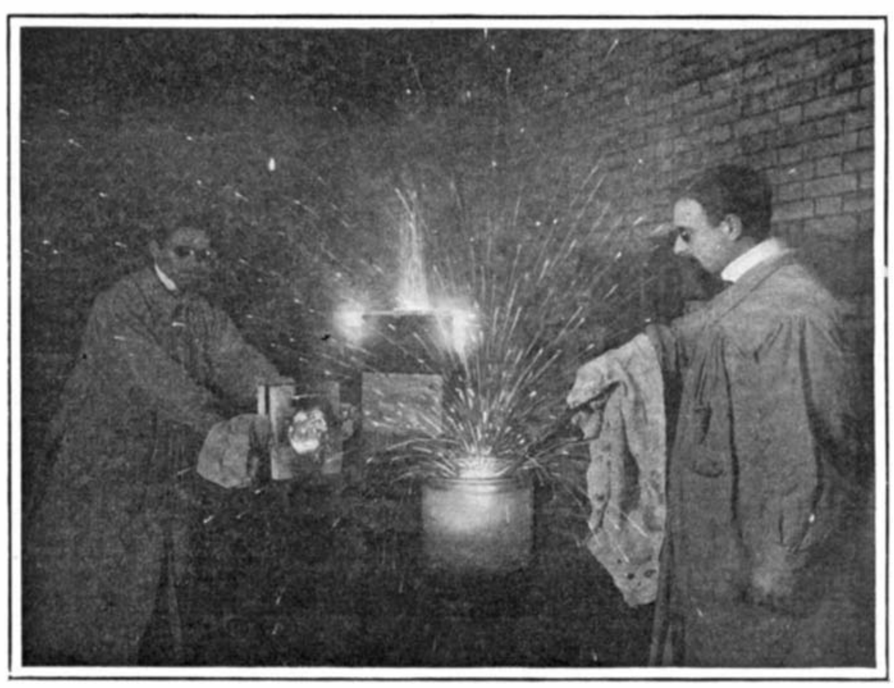
In a Carbon Crucible the Mixture of Carbon and Iron is Poured, Which, After Fusing at 5,000 Degrees, is Suddenly Cooled so as to Form Diamonds by Contraction.



The Chalk Block is So Poor a Conductor of Heat That a Lump of Ice Placed upon It Melts but Slowly.



Sand Begins to Boil and to Volatilize. Finally It is Deposited in an Impalpable Powder on a Watch Crystal.



When the Furnace Has Done Its Work the Crucible, White Hot, is Plunged into Melted Lead or Cold Water. The Sudden Contraction and Consequent Pressure Produce the Diamond.

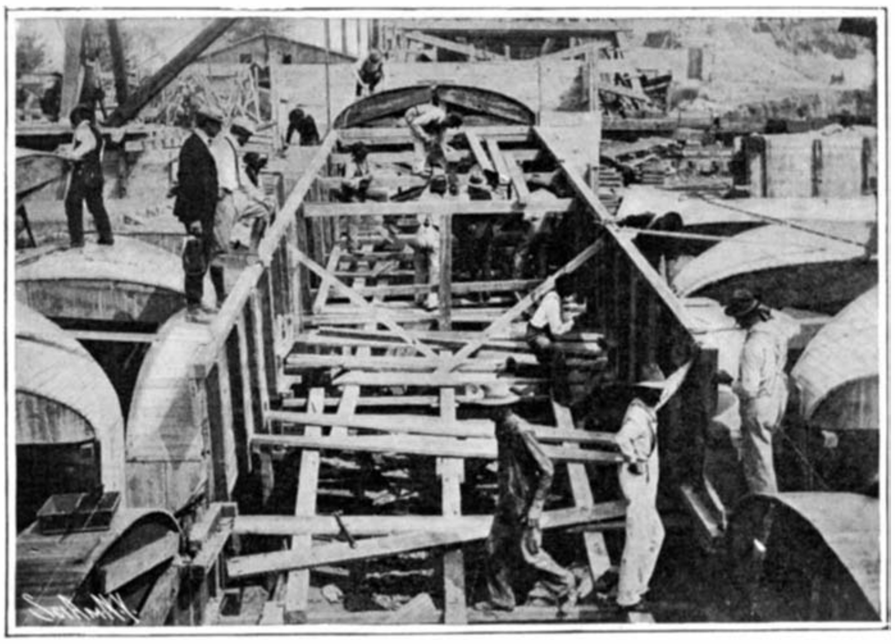
FIVE THOUSAND DEGREES OF HEAT.

A MODERN FILTRATION PLANT.

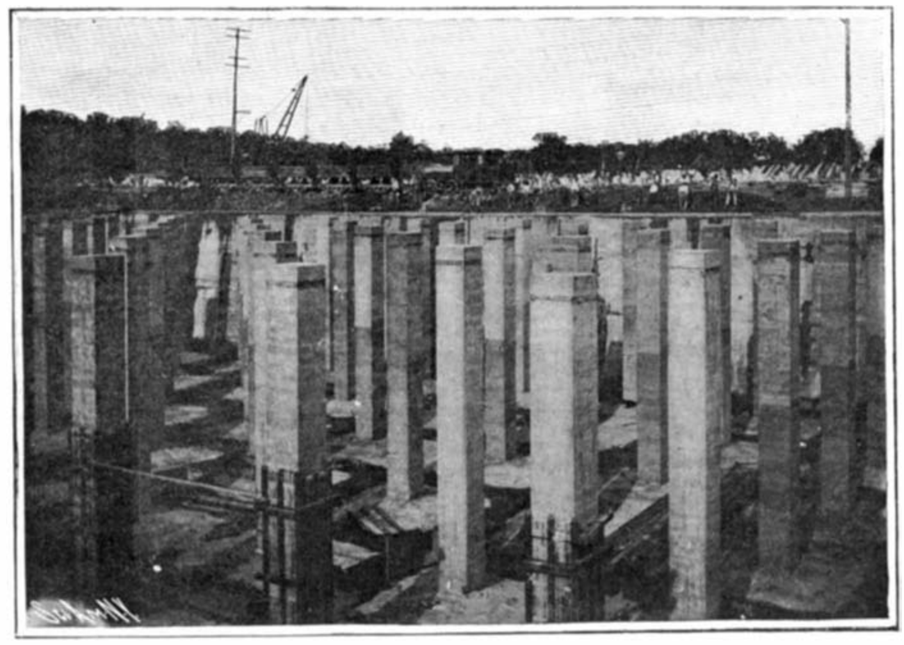
BY JAMES G. FERNALD, L.H.D.

Modern methods of filtration, like all that is best in scientific attainment, reach their result by closely copying nature. They build on a vast scale subterranean sand-beds, where the gathered water percolates through into the city mains, as it does by natural process into the deep well or the mountain spring.

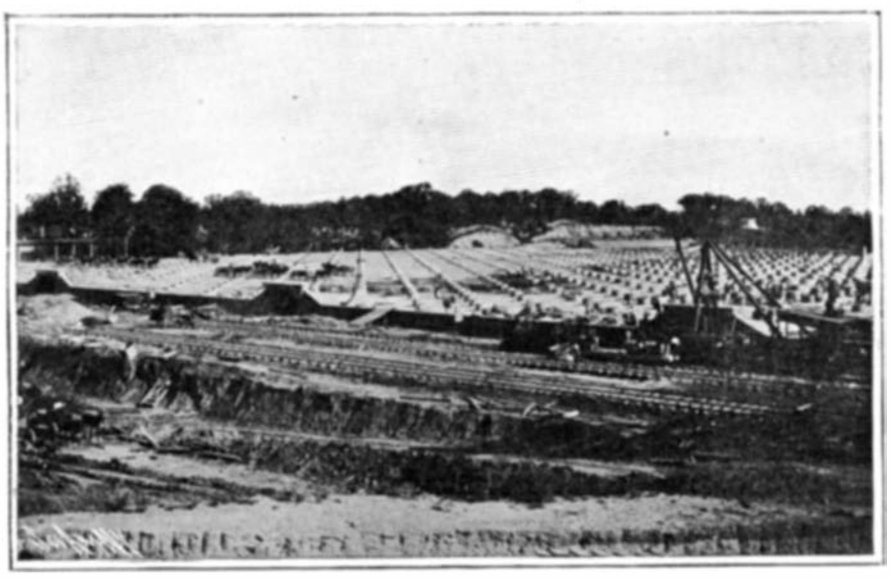
Of the way in which this is done, the filtration plant now in course of construction at Washington, D. C., the second largest in the world, is a good illustration.



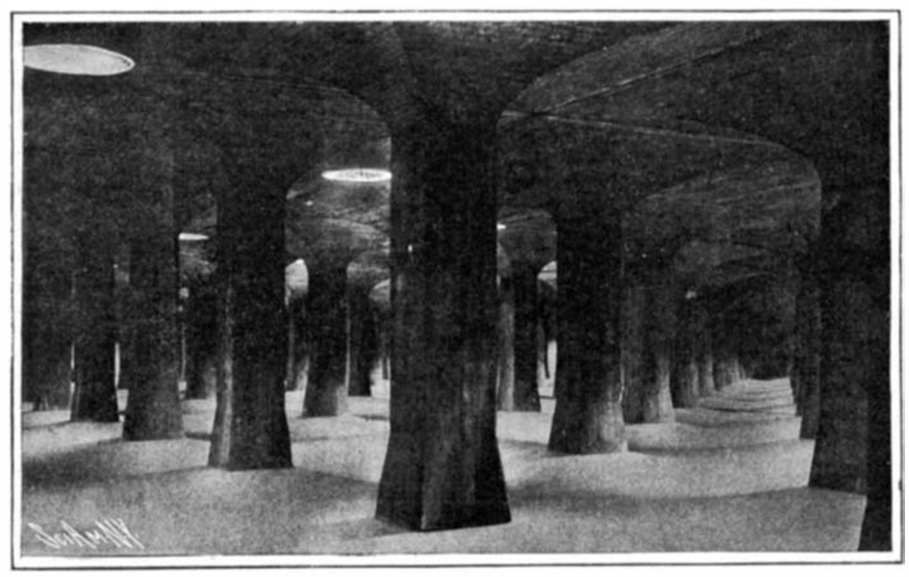
Fitting the Wooden Frames for Concrete Roof of Filters.



Part of Filtered Water Reservoir, Showing Pillars Twenty-Seven Feet High.

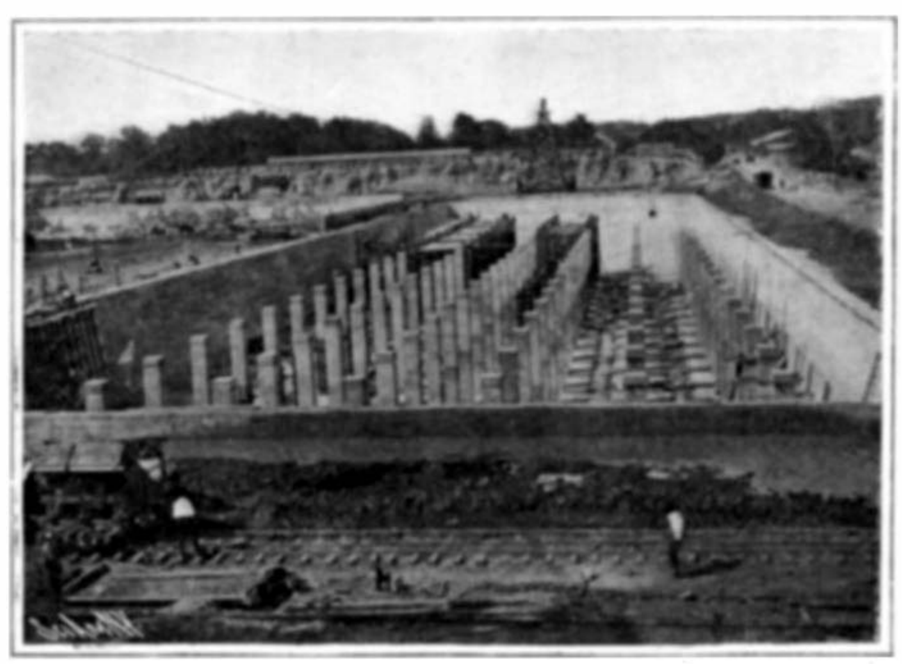


General View of Filtration Plant.



Interior of Filter.

Construction Work of Filtration Plant.



Partly Completed Filter.

A MODERN FILTRATION PLANT.

The water is drawn from the Potomac River above Great Falls, at a point 14 miles from Washington, whence it is brought to the city through a circular conduit of brick, which is 9 feet in diameter, and has a fall of 9½ inches to the mile. President Washington estimated that the city which he planned would require 8 million gallons of water daily. The present aqueduct has a daily capacity of 75 million gallons, and engineers are urging the immediate increase of this supply by paralleling the existing conduit with another of the same dimensions.

After entering the conduit at Great Falls, the water flows 9½ miles to the Dalecarlia reservoir, which has a capacity of 150 million gallons, and was originally constructed by the damming up of the Little Falls branch of the Potomac, and which is entirely without lining of stone of any sort. Thence the water passes through a similar conduit for a distance of 1.1 miles into the old distributing reservoir, which has a total capacity of about 151 million gallons, and has paved slopes—it also being divided into two basins containing 98 million gallons and 53 million gallons respectively. Thence the water passes into the Washington city tunnel, commonly known as the Lydecker tunnel, which is 3-9 miles in length, to the Washington city reservoir, which has a total capacity of 300 million gallons. This, in addition to the Reno reservoir, and the Brightwood reservoir, gives a total storage of 635 million gallons, or about 9 days' supply, assuming 75 million gallons daily consumption.

The water as it now comes from this reservoir into the homes of Washington is often so muddy that one hesitates even to wash in it. Yet this is the water that Washington is compelled to drink. Many persons of course buy spring or other bottled waters. But these cannot be used for cooking on any great scale. So the people are fain to use the muddy hydrant water and hope for the best. Worse than the mud, however, are the unseen germs which the scientist's microscope discovers. In fact, the muddy water is the purest. It is after rains or freshets, when a flood of fresh water has been poured into the river, that it comes down charged with earthy matter and looks so forbidding. But in quiet times, when animal and vegetable matter decays on the banks and is washed into the stream by occasional showers, or blown upon its surface by the wind, the clear water may be and often is much more fully charged with dangerous microscopic life.

The filtration plant that Washington is building to meet the city's need covers 29 acres, each acre a separate unit or section of the system.

As you stand at the southern gate of the Soldiers' Home and look southward toward the city, you see great fields covered with rows of small circular ridges looking like corn fields, with the hills rather large and rather far apart, and without the growing corn. Those circular ridges are the rims of the manholes that let

light and air as needed into the filter below. These manholes are 3 feet in diameter and 28 feet apart, and are guarded with double covers, so that they may be opened or closed as occasion demands. The filters are built in double lines, intersected by depressed roads, on which great double gates open, through which the filter may be entered for cleansing purposes at suitable times. Long aisles stretch away between rows of pillars.

As you look down at the floor of the partly completed work, you see that the groined arches overhead are repeated there inverted.

At the apex of many of these inverted arches may be seen openings leading downward, which are to carry the collected water after passing the filter into 2-foot mains that run under the floor. Lines of split tile with uncemented joints are laid with the convex side upward across the unpierced arches to reach these openings, along which the water will find its way as it does through a tile underdrain in a wet meadow.

Over the floor thus prepared is spread one foot of fine washed broken stone, and above this fine, clean sand is laid 4 feet deep When this has become thoroughly settled, water will be let in from the pumping house with even flow till it reaches the depth of 4 feet above the sand, at which depth it will be maintained with unvarying accuracy by an automatic apparatus in the pumping house.

The filling of the filter is a very nice undertaking. It must be filled backward. When the broken stone and sand are well packed, water is let in through the mains underneath, and allowed to soak up gradually through the mass till the whole is thoroughly wet. By this slow absorption the sand is evenly moistened and firmly packed together.

Then the water may be let in over the top. But even then it is not allowed to flow directly upon the sand lest it disturb the surface and start a washout, which the water will wear more and more, going down deep, stopping just 4 inches short of the upper rim of the manholes, so that no surface water can enter by way of the manholes. But how is the surface water falling in every rain to be kept from converting this earth covering into a swamp, and gradually working rifts, as water will, through the masonry of the roof? This is prevented by an ingeniously simple device. In the center of each pillar is set a 2-inch terra-cotta pipe, bent with an elbow so as to come to the surface of the north face of the pillar one foot above the level of the sand in the filter. Over the top of the pier, where the radiating arches spring, there is naturally a sump or depression. The terra-cotta pipe set in the stone of the pier opens upward in the center of this depression. Over the top of each of these pipes is placed a brass-wire screen, and over this 1 cubic foot of fine gravel and 11 cubic feet of sand. Thus water can never gather in pools upon the roof and become stagnant, but must work its way down through these prepared channels, and in going down must pass through sand and gravel, by which any impurities it may have gathered, as of decaying vegetation, will be mostly removed before it joins the mass of water in the filter below, again to pass through 5 feet of sand and gravel before reaching the underlying mains.

The filters are to be cleaned once a month, one filter a day, so that it will take practically a month to clean the whole plant. In cleaning, about one inch of the top surface of the sand will be carefully scraped away and removed. So carefully must this be done, that the workmen who do it will be required to wear flat-soled wooden sandals about 18 inches long by 6 inches wide, on which they go skating or sliding over the surface, where any dent of a boot heel might start a washout, through which the water would ultimately rush unfiltered. The water pressure will be very great, because each filter will contain water covering a surface of approximately 45,000 square feet and 4 feet in depth, giving 180,000 cubic feet of water, which at an estimate of 63 pounds per cubic foot, would weigh 11,340,000 pounds.

through it in a stream unfiltered, instead of working its way through drop by drop. So the new water is let in behind a detaining wall, the top of which rises just 3 inches above the surface of the sand, so that the incoming water flows slowly and evenly over upon the sand.

Here then we have the subterranean waters in cool dark chambers under the earth, slowly trickling down through fine, clean sand, the nearest artificial reproduction yet attained of nature's great filter that supplies the wells and springs.

The whole vast structure is built of concrete, which is really artificial stone, prepared by mixing 1 barrel of cement with 11 cubic feet of sand and 19 cubic feet of broken stone or gravel. It has been found that an arch of concrete so prepared will bear practically any weight that can be piled vertically above it. These arches are of 14-foot span, the concrete being 6 inches thick at the crown of the arch.

A visitor to the filtration plant sees vast piles of wooden forms of various shapes lying ready to be carried where they may be put in place to have the concrete masonry formed upon them. The work is necessarily slow, because the concrete is so thinly spread over so vast an area. The forms must be carried by hand from point to point, a dozen or fourteen men carrying one form, and carrying it no faster, of course, than a man can walk, to the place where it is to be set up. After the concrete has hardened, the forms must be removed and carried to a new place by the same slow process. So the inverted arches are formed for the foundation. Then the pillars or piers, monoliths of concrete 10 feet high and 22 inches square, are built where they are to stand. Looking across the partly-completed filters, one sees long rows of these roofless columns like the ruins of some newly-excavated Pompeii. When these are ready, the arched wooden forms are placed upon them, and the concrete spread above, which is to set into solid stone for the arches of the wide roof.

Over the roof is laid a level covering of earth 2 feet

When the water has passed down through the sand and broken stone into the underlying mains, it flows through these to the "regulator houses," of which there are six, neat brick buildings, each controlling five filters. The water from the five filters is conducted into a central chamber in the "regulator house," and from this through 48-inch mains to the "filtered water reservoir."

This is a vast underground structure, 612 feet long by 162 feet wide, the roof of which is formed of arches 18 feet in span resting upon columns of monolithic concrete masonry, 2½ feet square and each 27 feet high. As one walks through the empty structure now the likeness to a vast cathedral is still more impressive than under the arches of the filters. This reservoir will hold one-third of a day's supply for the city (25 million gallons). This supply must of course be drawn off three times every day, which is to be done by five great engines in the Trumbull Street pumping station, to which the water is conveyed by four 48-inch mains from the filtered water reservoir.

The filters have been described as subterranean. They are, indeed, largely built upon excavated ground, but even so they are higher than the water in the Washington city reservoir, from which their supply is drawn. This makes necessary a special pumping station in connection with the filter plant, having for its sole work to raise the water from the reservoir and distribute it to the filters. The completion of the work is promised by September, 1905. The total cost is estimated at $3,000,000.

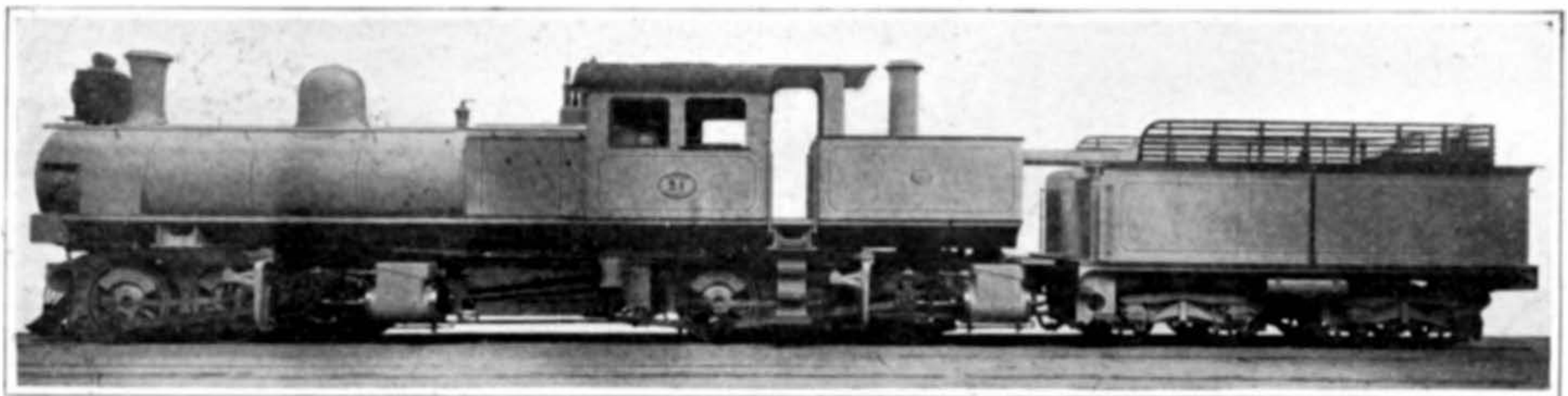
The earth covering the roofs of the filters will be sown to grass, and the intersecting streets paved and parked, so that, with the vast lake of the Washington city reservoir on the west, the wide lands of the Soldiers' Home stretching far to the north, and the Capitol, the city, and the Washington Monument full in view as one looks southward from this elevated ground, the Washington filtration plant will be an added ornament as well as a source of incalculable benefit to the beautiful and rapidly-growing capital city.

A UNIQUE LOCOMOTIVE FOR SOUTH AFRICA.

BY F. C. COLEMAN.

For working heavy freight trains over the severe grades and sharp curves encountered on the Rhodesia railway, which has now been recently extended to Kalomo, 90 miles to the north of the Victoria Falls, and which is destined to form a very important link in the projected Cape to Cairo railway, a unique type of locomotive, illustrated herewith, has been introduced into service. This engine is divided into three main portions—the superstructure and two steam-driven trucks. The superstructure consists of boiler, coal bunker, water tanks, and cab, which rest on two long girders, that are themselves carried at two pivot points on the six-coupled trucks. By this means the whole weight of the engine is upon the coupled wheels, and is, on that account, available for adhesion. It can be accurately adjusted by means of a special spring connection, introduced at a selected position away from the center of the bogie; and as the wheel-base of each engine is not more than 8 feet 6 inches, the engine here illustrated, which weighs 81 American tons, can pass round curves of three chains radius without causing the slightest injury to the road-bed. In addition to the advantage of traversing these severe curves, the line of pull from the engine itself is kept in a position which reduces the side resistance at the pulling end. Each bogie is in itself an engine, with a pair of cylinders, valve motion, brake gear, and sanding gear complete, and bears the weight of half of the superstructure on a recessed steel casting. There are bolts passing through slot holes in these castings, which form a connection between the bogie and the superstructure, and a further security against an excess of movement is provided by the addition of check chains. The mechanical details by which the power is supplied and controlled for each of the bogies have been carefully designed. The steam is carried from the front end of the boiler by means of ball-and-socket joints to each pair of cylinders. The exhaust of the front bogie is carried through the smokebox, and is sufficient to keep up a draft through the fire-box, and so maintain steam. The exhaust steam of the hind bogie is passed into the atmosphere, but could be utilized either for the purpose of increasing the draft or for an exhaust steam injector, if required. The driver supplies steam to both sets of cylinders by one movement of the regulator handle, and in the same manner he is enabled to reverse both engines, put the brake on, and actuate the sanding gear by one movement of each of the handles concerned. There is no difference in the method of lookout, or of handling the engine, from the practice of ordinary locomotives. The boiler is of the "Belpaire" type, so commonly used on British railroads, and provides a specially la... steam capacity and the usual facilities for washing out, etc. The locomotive was built by Messrs. Kitson & Co., of Leeds, England, and as illustrative of its great hauling capacity, it may be stated that the engine illustrated herewith is now regularly drawing twice the train loads formerly hauled by the most powerful locomotives on the Rhodesia railroad.

Each bogie has six wheels coupled, each of 4 feet diameter, and two outside cylinders of 16 inches diameter by 24 inches stroke. Other dimensions are: Heating surface, firebox, 136 square feet; tubes, 1,590 square feet; total heating surface, 1,726 square feet. Grate area, 34 square feet. Internal diameter of boiler, 5 feet. Length of boiler, 13 feet 4 inches. Thickness of boiler, 9-16 inch. Boiler pressure, 180 pounds per square inch. Length of firebox, 8 feet 3 inches. Height from rail level to top of funnel, 12 feet 10 inches. Height from rail level to center of boiler, 7 feet 2 inches. Rigid wheel-base, 8 feet 6 inches. Total wheel-base, 34 feet. The engine tank has a fuel capacity of 3 tons of coal. The tender has a capacity of 7 tons of coal and 2,855 gallons of



Each Truck is Driven by Its Own Complete Engine. The Smokestack at Back of Cab is for the Exhaust of Rear Engines. Weight of Engine is 81 Tons.

ARTICULATED LOCOMOTIVE FOR THE RHODESIAN RAILWAY.

water and, when fully loaded, weighs 47 American tons. When in working order, the total weight of the engine and tender is 125 American tons. On a gradient of 1 in 66 combined with a curve of 10 chains radius, the engine will haul a load of 624 tons (exclusive of weight of engine and tender) at a speed of 8 miles per hour with 75 per cent cut-off.

RESULTS OF THE HILL-CLIMBING CONTEST AT MOUNT WASHINGTON.

During the stay of the Glidden tourists at Bretton Woods, N. H., the second hill-climbing contest up the 8-mile road on Mount Washington was held. The rough character of this road, and the sharp turns encountered upon it, are noticeable in the accompanying photographs, which show the winning 60-horse-power Napier car (time, 20 minutes, 58 2-5 seconds), the 3-horse-power Indian motor bicycle (which required only 4-5 second more in which to make the ascent), and the 8-horse-power double-opposed cylinder Maxwell runabout with bevel gear drive, which took second place in the class for cars weighing 851 to 1,462 pounds. The time of this machine was 51 minutes, 41 3-5 seconds, the only car in its class to beat it being a 15-horse-power Stanley steamer, which reached the top in 27 minutes, 17 2-5 seconds. A 16-horse-power, four-cylinder, air-cooled Marion car reached the summit in 1:10:57 4-5, and gained third place in this class.

In the free-for-all contest a four-cylinder, 60-horse-power Napier car, driven by W. H. Hilliard, won in 20 minutes, 58 2-5 seconds. This was 3 minutes, 41 1-5 seconds better time than that made last year by Harry Harkness on his 60-horse-power Mercedes; and the new record was made despite the fact that the car stopped at least half a minute on the way up, because of a broken battery wire. The most sensational performance of all, however, and the one which caused the greatest surprise, was the dash up the mountain of the 3-horse-power Indian motor bicycle mounted by Stanley F. Kellogg. The rider did not dismount from start to finish. Nearly 3 miles from the summit he ran into a dense fog, which made the ride all the more dangerous. But in spite of all difficulties, he reached the top of the mountain in the remarkable time of 20 minutes, 59 1-5 seconds. A second Indian machine of the same power also made the climb in 22 minutes, 42 seconds. A Stanley steamer driven by F. E. Stanley made the second best time in 22 minutes and 17 seconds.

In the light-weight class, for cars weighing from 557 to 851 pounds, the Stanley steamer was again first in 30 minutes, 34 3-5 seconds; while a 16-horse-power, four-cylinder air-cooled Cameron machine was second in 1:03:24 2-5, and a 10-horse-power Crawford car third in 1:11:35 2-5.

In the contest for runabouts selling for $650 or less, two Oldsmobiles made the climb in 56 minutes, 10 4-5 seconds and 1 hour, 20 3-5 seconds respectively.

In the class for cars listing at from $1,000 to $2,000, a Reo won in 52 minutes, 35 2-5 seconds; a Maxwell was second in 1 hour, 27 seconds; and a Columbia third in 1 hour, 7 minutes, and 14 seconds.

In the $3,000 to $4,500 class, a 45-horse-power Pope-Toledo was first in 29 minutes, 37 2-5 seconds; a Pierce second in 38 minutes, 45 seconds; and a White steamer third in 41 minutes, 35 4-5 seconds.

A 50-horse-power Richard-Brazier car made the time of 26 minutes, 38 2-5 seconds; and a 20-horse-power double-opposed cylinder Buick, 36 minutes, 25 seconds.

The day after the conclusion of the hill climb, which was held on July 17 and 18, the tourists for the Glidden trophy ran to Concord, N. H., a distance of 103 miles. Heavy thunder showers were encountered, and twice the Packard truck skidded off the road. All the machines reached Concord safely. The following day a run of 99 miles was made to Worcester, Mass., where some excitement was caused by the arrest of eight of the tourists for exceeding a local speed limit of 12 miles an hour on the outskirts of the town of Leicester when on their way to the White Mountains the week before. Two constables claimed that they timed the cars for a distance of 300 feet at the foot of a hill just before they made the ascent of another one. No warning was given that speed should be reduced, and the constables took advantage of the contestants' lack of knowledge of the local ordinance to mulct them $17 apiece. Such treatment of tourists in the State of Massachusetts, especially when they were making a reliability run under the auspices of the American Automobile Association, only goes to prove the mistake of legislators when they frame laws making possible a different speed limit for every hamlet, village, or town. The abolishment of the speed limit altogether, and the making of arrest possible only for furious or dangerous driving, is the only proper way of curbing the men with scorching propensities.

An 8-Horse-Power Maxwell Runabout Making a Turn on the Way up the Mountain.

This little two-cylinder car made the best time of any gasoline machine in the 851–1,462 pound class. It obtained second place in 51 minutes, 41 3/5 seconds, being beaten only by a 15-horse-power Stanley steam machine.

Kellogg on His Indian Motor Cycle Making the Climb in 20 Minutes, 59 1-5 Seconds.

This remarkable performance, which was accomplished in only 4/5 of a second more time than that required by the 60-horse power Napier car, was made by a 3-horse-power two-cylinder motor bicycle having the cylinders placed like a letter V.

Hilliard's 60-Horse-Power Napier Ascending the Mountain in 20 Minutes, 58 2-5 Seconds.

This record, which is 3 minutes 41 1/5 seconds better than that of last year, was made despite a stop to repair a broken battery wire.

RESULTS OF THE SECOND "CLIMB TO THE CLOUDS" UP MOUNT WASHINGTON.

Fast Long-Distance Trains in Great Britain.

Owing to the great success that attended the development of fast long-distance express trains by the various railroads of Great Britain last year, these services are considerably extended for this season. The feature of these trains is not only great acceleration in speed, but the absence of intermediate stops upon long distances. The most important of these new services is the introduction of non-stop expresses upon the London and North-Western Railroad between London and Liverpool, which are to cover the distance of 192 miles in 208 minutes, equivalent to a speed of 55.307 miles per hour. The distance of 196 miles between London and Leeds is to be accomplished by certain of the Midland Company's trains without any intermediate stoppage in 225 minutes—52.22 miles per hour; and 210 minutes required by the expresses of the Great Northern Railroad between the same two cities, a speed of 56 miles per hour. The Great Western Railroad is maintaining the non-stop expresses between London and Plymouth, which it successfully introduced last year. In this case the distance is 245¾ miles, and is covered in 265 minutes, which is equal to 55.64 miles an hour. This is the longest non-stop run in the world, and in view of the many difficult gradients on the road, the average speed is a creditable one. The fastest speeds, however, are being recorded upon the Great Central Railroad between London and Sheffield, 164¾ miles in 170 minutes, 58.14 miles per hour. As, however, for a distance of 38 miles this Great Central runs over the track of the Metropolitan Railroad, speed has to be limited; but between Aylesbury, where the Great Central road commences, and Sheffield, a distance of 126¾ miles, the journey is covered in 120 minutes, which represents a speed of 63.37 miles per hour. In point of distance this is the fastest express in Great Britain. Notwithstanding the speed of these expresses, extraordinary precaution is taken to insure the safety of passengers. Some idea of the extent of these precautions may be gathered from the fact that on the round trip between London and Liverpool, a train is controlled by over three hundred semaphores.

The earlier wooden and iron bridges were built very much in the same manner as the ancient Roman bridges, in accordance with empirical rules, by practical men who had no accurate knowledge of the strains produced on the various members of a structure by the exterior forces, but who were men of unusual constructive ability and sound judgment, who had to depend upon their own resources and natural instinct, experimenting with models and profiting by previous failures. Practice always preceded the science, thus the structural systems were invented before their theory was developed.

A NEW GAME OF TABLE BILLIARDS.

In addition to the great inventions that are of utility to man, there are certain minor ones that are designed to minister to his amusement. To this latter class belongs the game of table billiards recently devised by Herr Kögel, and illustrated in the accompanying picture. The apparatus consists of a circular flat-bottomed box supported by a stationary foot, two leveling screws, a spirit level, a set of balls, and a top.

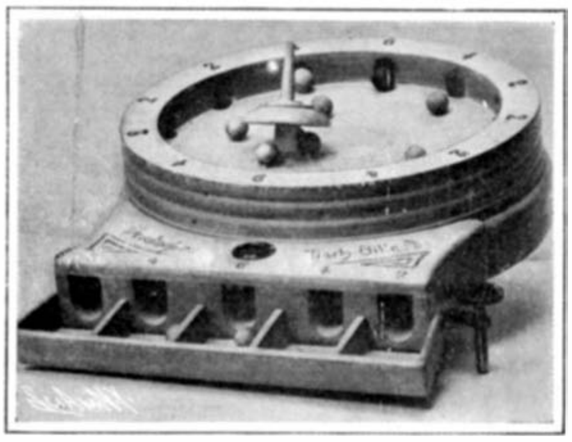


TABLE BILLIARDS.

The leveling screws and spirit level permit of quickly giving the box a horizontal position upon any sort of table. Along the periphery of the box, internally, there are apertures forming entrances to channels arranged beneath. The two series of these apertures situated on each side of the wall of the box communicate with corresponding channels, and the two situated in the median axis communicate with the median channel. The channels open into a partitioned case placed in front.

In order to play the game, eight or twelve balls are placed upon the bottom of the box, and the top is then spun by means of the thumb and forefinger. The top is of a square section beneath, and, during its revolution, throws the balls, which at the outset are assembled at the center of the box, to the sides of the latter, whence, rebounding, they traverse the bottom, and finally assemble anew at the center, whence they are again thrown by the top against the sides. During their motion, a certain number of the balls enter the apertures in the side of the box, and, following the corresponding channels, reach the compartments of the case beneath. After this the number of balls in each compartment are counted, and the player making the best score wins the game.

A NEW METHOD OF HANGING WINDOW SASHES.

Something decidedly original in the hanging of window sashes is illustrated in the accompanying engravings. It consists in linking together the two sashes of the window in such manner that the weight of one serves as a counterbalance for the other. No sash-cords, weights, or pulleys are necessary, and the disadvantages attending their use are thus entirely avoided. The space taken up by the sash weights is considerable, and in some cases architects find it almost impossible to make room for them. The cords, too, are in time weakened, either by wear on the pulleys or decay, and are liable to break. But aside from this the sash must fit loosely in its frame so that it will slide freely, with the result that the window is drafty and rattles in windy weather. That the new construction possesses none of these disadvantages will be apparent on studying the accompanying engravings. The sashes are connected at their sides by levers, *A*, fulcrumed at their centers to the window frame. The upper sash is provided near the top with a pin at each side adapted to travel in a groove in the window frame, and the lower sash is provided with bolts, *D*, which serve as pins but which may also be pushed home to lock the sash in various positions. When the lower sash is raised its upper end swings outward and the upper sash is lowered, owing to the lever connections, *A*. Fig. 4 shows the window open to its fullest extent; but if the levers, *A*, are made longer it will be evident that the window can be opened as wide as any sliding sash window. If desired, the lower sash may be swung out at the top without raising the bottom, which is bolted to the frame, as in Fig. 2. A window may be thus locked open at night, providing an ample circulation of air without fear of sneak thieves. This arrangement, it will be seen, opens the window at the center to admit fresh air which, owing to the inclined position of the sash, is directed upward to prevent a draft. The impure air at the same time flows out at the top. Fig. 3 shows the window open at top, center, and bottom. A false sill is hinged to the lower sash, and this may be swung down to close the opening at the bottom of the window, if desired. When the window is closed, as in Fig. 1, the levers, *A*, act to jam the sashes tightly against the parting bead, rendering the window watertight. If, in case of a driving rain, any water should leak past the parting bead, it would be caught in the grooves, *C*, and flow back to the sill. By avoiding the use of weights, the windows may be made 6 inches wider on each side, providing a material increase in the light area of such buildings as factories and the like. This window construction also offers the further advantage that the glass may be cleaned from the inside of the room. The bottom sash may be unbolted and drawn in to bring both sides within easy reach for cleaning. To clean the outside of the upper sash, a portion of the parting beading is removed by turning the thumb-screws, *B*, which permits the sash pins to slide out of the grooves, *C*. The sash may then be swung inward on the levers as a fulcrum to the position shown in one of our illustrations. The inventor of this improved window is an Australian, Mr. Alexander Knox, now at 703 Times Building, New York city, N. Y.

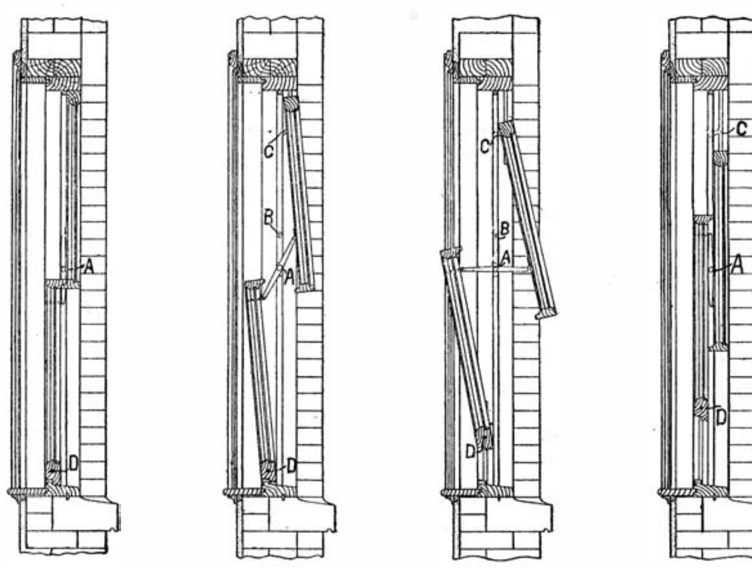


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Various Positions Occupied by the Counterbalanced Windows.

Top Sash Swung in for Cleaning.

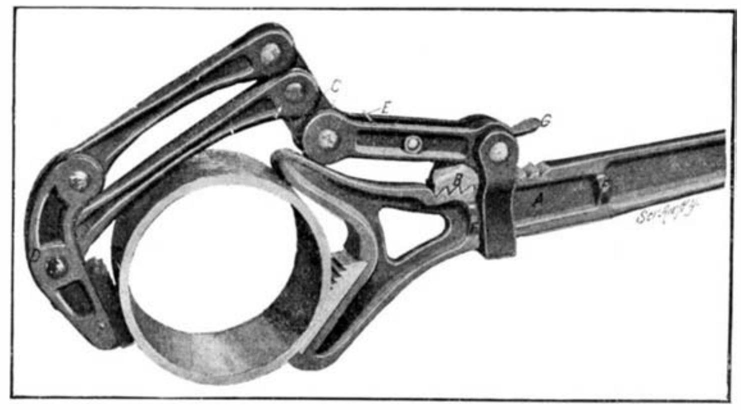
Cleaning the Lower Sash.

A NEW METHOD OF HANGING WINDOW SASHES.

When the long-distance wire now being laid between Denver, Omaha, and Kansas City has been completed, there will be a direct telephone communication between New York and San Francisco, which are nearly 4,000 miles apart.

AN IMPROVED PIPE WRENCH.

An improved pipe wrench has recently been invented, which may be quickly adjusted to take various sizes of pipes or nuts, and which will act with a maximum of power without unduly mutilating or marring the article gripped. Furthermore, the gripping jaws will be readily disengaged from the article when pressure is released from the handle. In the illustration a portion of the handle, *A*, is shown. This, it will be observed, terminates in a Y-shaped jaw, in which a serrated steel piece is set. A yoke strap on the handle carries a pawl, *B*, which engages teeth formed in the upper edge of the handle. The strap also carries a pair of arms, which at their outer ends are pivoted to the rear yoke head, *C*. The latter is connected by two links with the forward yoke head, *D*, which at its lower end carries a jaw pivoted thereto. In use, to adjust the wrench to any desired article, the pawl, *B*, is lifted by depressing the end, *G*, then the jaws are moved against the article. On releasing the pawl the spring, *E*, presses it into engagement with the teeth on lever, *A*. Then, when the lever, *A*, is moved, the jaws are brought together with a powerful gripping action, due to the leverage of the yoke heads and links. The wrench has a wide range of adjustment, which is limited only by the stops, *F*, coming in contact with the yoke strap. The inventor of this improved wrench is Mr. Patrick F. Duross, of 57 North Pierce Street, Flushing, New York.



AN IMPROVED PIPE WRENCH.

Mine Explosions.

There is a peculiarity often manifested in regard to the evidences of violence at different points. Too often it is assumed that a fresh body of firedamp or a keg of powder has been exploded at such points. The greatest violence is generally manifested at the point developing the greatest resistance, when that resistance gives way under the pressure. The expanding air of an explosive blast may cushion from one point in the mine to another. A temporary cushioning of the blast by a contracted passageway, or other heavy obstruction, may have the effect of transferring the pressure from the starting point, where destructive violence is usually manifest, to a point where the obstruction was met. This cushioning effect may be so complete that between these two points there is perhaps little sign of the passage of the blast in that direction. There is seldom any evidence of violence manifested inby or toward the face from the initial point of an explosion, owing to the cushioning of the air in this direction.—Mines and Minerals.

Until 1847, when Squire Whipple, the modest mathematical instrument maker, who, without precedent or example, evolved the scientific basis of bridge building in America, correct methods of computing the strains in framed structures were not known. A few years later, in 1851, Herman Haupt published a book on the theory of bridge construction. About 1850, after the building of railroads had advanced, the educated engineer commenced to exert his influence in the art of bridge building, and, from that time forward, steady progress was made. The period from 1850 to 1860, therefore, may be regarded as an epoch in the history of American bridge building; the time when the bridges designed by Fink and Bollman first came into use.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

TELEPHONE ATTACHMENT. — F. F. Howe, Marietta, Ohio. This invention is an improvement in telephone-receiver supports; and it consists of a universal jointed arm which holds the receiver and permits the latter to be moved into position against the ear. This movement works a lever which is connected with the switch of the telephone in such manner as to cut the receiver into circuit.

AUTOMATIC TAKE-UP DEVICE FOR TELEPHONE CONNECTIONS.—F. B. Long, Los Angeles, Cal. One of the principal objects of the inventor is the provision of means for storing the electrical connections for the receiving and transmitting instruments of an ordinary telephone in such manner that during the time the instruments are hung up or out of use there will be no slack or loose portions of the connections hanging about the telephone.

TELEPHONE ATTACHMENT. — V. Rebhun, Schaghticoke, N. Y. The more particular object of this inventor is to provide means for improving the acoustic effects of the receiver, to enable the operator to avoid holding the receiver by hand, to enable the receiver to be adjusted to various positions of the head, and to accommodate the receiver to the use of persons whose hearing in one ear is better than in the other.

ELECTRIC TEMPERATURE-ALARM. — C. P. Hepler, Smithton, Pa. The invention refers to a device for application to a receptacle and designed to give a signal when any certain predetermined temperature is reached in the receptacle. The principal objects are to provide an alarm which can be easily set for any desired temperature, which will be entirely automatic in operation, useful in a large number of different kinds of business—as, for example, distilleries, breweries, bakeries, confectioneries, etc.—and which will be simple in construction and easy to maintain.

Of Interest to Farmers.

LEVELING ATTACHMENT FOR SEPARATORS.—O. G. Vold, Dawson, Minn. The object of the invention is to provide a new and improved leveling attachment for portable grain-separators and similar machines on wheels and arranged to permit convenient application to the machine without altering the construction thereof and to form level furrows for the wheels of the machine to stand in.

TANK-HEATER.—W. Dixon, Kimball, Minn. The object of this invention is to provide a heater arranged to prevent the seam of the heater-body from coming in contact with the burning fuel, to prevent the seam from becoming leaky, and at the same time providing a space within the heater-body unobstructed by the draft-flue to provide ample space for the burning fuel. It relates to the care of live stock, and more particularly to heaters for use in stock-tanks to prevent the contents from freezing.

FURROW-OPENING DISK. — H. C. Ham, Liberty, Ind. The invention relates to implements which comprise rotary disks in their make-up, which disks roll upon the ground as the implement advances. While intended to be used especially in connection with furrow-openers when used in planters or seeding-machines, it should be equally useful in the construction of disk harrows and other agricultural implements employing disks for any purpose. Improved means are provided for attaching the disks.

MACHINE FOR TOPPING BEETS.—A. H. Kramer, Montevista, Col. The purpose of the improvement is the provision of durable and effective devices for topping the beets and means for controlling the topping devices, so that whether or not the beets extend more or less out of the ground all of the beets will be topped in a uniform manner. It may be quickly brought into action and as rapidly and readily carried out of action, on entering or leaving a field.

BROODER.—G. H. Lee, Omaha, Neb. The object of the inventor is to produce a brooder of simple construction provided with improved means for diffusing the heat supplied thereto and provided also with an improved arrangement for hovering or covering the chicks within the brooder, one of his purposes being to prevent the tendency to crowding of the chicks in the heated space.

INCUBATOR. — G. H. Lee, Omaha, Neb. The inventor's object in this instance is the provision of a construction which conduces toward a thorough circulation and uniform heating of the air within the incubator, at the same time shielding the eggs from direct air-currents. The construction facilitates separation of newly hatched chicks from the eggs and also from chicks previously hatched and provides also an arrangement whereby it will be unnecessary to open the main door of the incubator in order to remove chicks from the interior.

Of General Interest.

MAIL-POUCH HANGER AND SHIELD.—G. A. Clark, Nashville, Tenn. The aim of this improvement is to provide a device whereby one or more pouches may be supported between the arms of the mail-crane, and to the manner in which such mail-pouches may be protected from contact with the receivers of the mail-pouch catchers.

TENT.—T. D. McCall, St. Louis, Mo. This invention is in the nature of an improved tent of the same general character as those heretofore patented by Mr. McCall, the same being light portable tents with the canvas floors forming a part of the tent. It is designed to provide a tent of this general character which may be used singly or in pairs to form a larger shelter-tent.

COMBINATION HAT, COAT, AND UMBRELLA RACK.—A. Abelson, New York, N. Y. In the present patent the invention has reference to combination-racks for the storage of articles, and more particularly to the type of rack suitable for storing hats, coats, and umbrellas so as to render the same comparatively secure. Piracy of articles is prevented by the fact that only a key of a certain type can be used to move the sliding plate or bolt from its position.

EDUCATIONAL DEVICE.—J. B. Olivera, Matanzas, Cuba. One purpose of the invention is to provide a means whereby children or students may not only familiarize themselves with letters of the alphabet, but may arrange them in words or series of words, and whereby the device may be placed on the desk of each student and a similar device be employed by the instructor to give the initial idea of the grouping of letters to form words, leaving pupils to themselves afterward to spell out the different words.

BARBER'S ANTISEPTIC UTENSIL. — H. Rosenthal, New York, N. Y. In the present patent the invention has reference to barber's supplies; and the inventor's object is the provision of a new and improved barber's antiseptic utensil, insuring to the person to be shaved at a barber-shop the use of an antiseptic-cup, an antiseptic brush, and antiseptic soap.

LEGGING.—J. W. Pynch, Ripon, Wis. One purpose of the improvement is to so construct a legging that it will lace at the front and so that the front will be open for the introduction of the foot only a portion of the length of the legging, the lower part of the front being permanently closed by a folding tongue. Further, to so locate and hold the lace at the bottom of the legging that it will not drop under the foot while the legging is being placed upon the person.

HOSE-COUPLING NUT.—W. C. C. Miller, Vacaville, Cal. The aim of this inventor is to provide details of construction for a nut which adapt it for a speedy and reliable connection of an end of a hose having the nut thereon with the threaded nozzle of a fire-plug and also for an instant connection or detachment of two sections of hose, one section having the improved nut on its end and the other section a male-threaded nipple, forming a reliable water-tight joint-coupling between the hose ends that are detachably connected by means of the improvement.

COUPLING.—R. G. McDowell, Anaconda, Mont. This coupling is intended for joining sections of pipe and hose and also for use in connecting nozzles and fire-plugs and various other analogous uses. It comprises mating sections fitting one within the other, the coupling having a peculiar packing, making a hermetic joint and the outer section carrying a peculiar spring-dog capable of projecting a part through an opening in the outer section into engagement with a shoulder on the inner section, thus removably yet securely holding the sections engaged.

HOISTING DEVICE.—J. Kambish, Jr., Piney, W. Va. The intention in this case is to provide a new and improved hoisting device, more especially designed for raising and lowering deep-well tubing, pump-rods, and the like, and arranged to allow convenient and quick raising and lowering of a load without much expenditure of power.

SHOE-LAST.—A. R. Garrod, New York, N. Y. The principal object of the invention is to provide a shoe-last of a construction by which to impart to the tread or under surface of the sole of a shoe made thereon a curvature or form tending to turn the foot of the wearer of the shoe in an outward direction in the act of walking.

STANDARD FOR SUPPORTING WIRES.—W. V. Gilbert, Port Elizabeth, Cape Colony. This invention is peculiarly valuable for purposes of fencing. It relates more particularly to a certain form of standard made, preferably, of sheet metal and formed from a blank of such metal bent into suitable conformity to be driven into the earth and to support the wires or cables, the standards being particularly adapted to be nested in order to save transportation expenses and possessing many constructional advantages.

SKIRT-GAGE.—Frances M. De Leon, New York, N. Y. This invention concerns itself especially with the construction of a skirt-gage, which is to facilitate the fitting of the skirt with respect to its length. The object is to produce a gage which will not only enable the skirt to be marked at the desired point at which the lower edge should be turned up, but also to provide an arrangement whereby the accuracy of the measurement is much enhanced.

PROTECTING BOX OR CASING. — H. W. Clark, Mattoon, Ill. This improvement is in boxes or casings for housing water-meters, stop-cocks, valves, and other water appliances and oil and gas appliances and distributers, also telephone and other electric conductors and appliances and protecting them from improper access or injury by contact and frost either below surface of ground or exposed places. The invention relates particularly to an improvement in the lid applied to the neck of the box-cover and means for fastening it, whereby it is held when in use yet adapted for detachment to allow access to enclosed meter for reading, detecting leaks, etc.

BOTTLE.—R. G. Davis, Hot Springs, Ark. In the present patent the invention has reference to improvements in bottles of the non-refillable class, the object being to provide a bottle of this character that will be of simple construction, practical to manufacture, with the valve mechanism so arranged as to prevent refilling, but permitting the ready outflow of liquid.

SURGICAL APPLIANCE.—A. Breslin and J. Lees, Summithill, Pa. The object of the invention is the provision of an appliance adapted for attachment to the body of a patient or sleeper to frustrate his attempts to turn to an inclined or other position and to retain him in the desired position without disturbing or awakening him. It is an improvement upon one for which the inventors have filed an application for patent, which has been allowed.

SLEEVE-PROTECTOR. — Helen Gardner, New York, N. Y. In the present patent the invention has reference to protectors for the sleeves of garments, having for its principal object the provision of an effective device of this class which while maintaining its position will neither interfere with the garment nor the movements of the wearer.

FOUNTAIN-BRUSH. — W. L. Payn, Checotah, Ind. Ter. In the present patent the intention of the inventor is the provision of a brush of this character which shall be adapted to contain and supply shampooing powder or fluid made into lather by the water supply through the brush and at the same time be useful for general bathing or washing purposes.

HOSE-COUPLING. — J. D. O'Brien, Mullan, Idaho. The principal objects of the invention are the provision of a secure device which may be readily connected and disconnected. The means provided make a fluid tight joint, effectually preventing leaking. Uncoupling the members is readily done. Uncoupling cannot accidentally occur under pressure or twisting of the hose. The packing-ring will stay in place whether members are coupled or uncoupled, but yet may be readily removed and renewed. There are no threaded or similarly-movable elements to effect the closure.

Hardware.

WRENCH FOR THRESHING-CYLINDERS. —M. Mahlen, Osakis, Minn. This invention relates to wrenches used in applying the nuts which retain the teeth of threshing-cylinders upon the bars thereof. The object is to produce a wrench which is so formed as to enable the same to be applied readily in practice, certain parts of the said wrench having useful functions in connection with the straightening of the teeth of a threshing-cylinder where they have become bent or twisted.

Heating and Lighting.

FURNACE. — G. S. Kent, Buffalo, N. Y. One purpose of the invention is to provide an improvement upon a furnace for which a former patent was granted to Mr. Kent, the main object of the invention being to so construct a furnace that it will be an overdraft-furnace and will have a vast capacity for producing heat and which will thoroughly burn fine coal before the fuel can escape to the ash-pits.

STRAINER AND SEPARATOR. — J. G. Anson, San Francisco, Cal. The aim of this invention is to provide a strainer and separator more especially designed for use in steam-generating plants using crude oil as a fuel in furnaces and the like and arranged to separate the water from the oil, to insure a thorough straining of the oil previous to the latter reaching the burners, and to allow quick and convenient cleaning of the device.

Household Utilities.

DOOR-HANGER.—H. Lobel, New York, N. Y. The invention refers to improvements in hangers for sliding doors, the object being to provide a hanger of simple construction and having means for so suspending a door that it will hang in direct downward alinement with the slide-bearings, thus preventing any vertical strain on the sliding member, and therefore permitting an easy sliding movement of the door.

SUPPORT FOR BED-BOTTOMS. — C. L. Harrell, New York, N. Y. Mr. Harrell's invention pertains to supports for springs or other bed-bottoms. His principal objects are to provide such a device which may be readily attached and which will furnish a general yield or spring effect to the entire bottom structure, even at the ordinarily-rigid edges.

KITCHEN-CABINET. — H. Clark, Whitefish, Mont. In this case the invention has reference to improvements in kitchen-cabinets particularly adapted for the use of pastry-cooks, an object being to provide a kitchen-cabinet so arranged that the several ingredients required for use will be conveniently at hand.

Hydraulics.

WATER-WHEEL.—T. Lambeth, Rachel, N. C. In this instance the invention pertains to improvements in water-wheels of the undershot type, the object being to provide a simple and novel means for positively moving the blades outward to receive the water-pressure and moving them inward or into the wheel-body upon leaving the water, thus preventing back pressure.

WATER-ELEVATOR.—J. J. Powers, Centralpark, N. Y. In Mr. Powers' patent the invention has reference to improvements on apparatus for elevating water from wells, the object being to provide a water-elevator of simple and novel construction and in which the water is forced to the point of discharge by air-pressure.

Machines and Mechanical Devices.

SAW-SET.—C. Diener, New York, N. Y. One purpose of the invention is the provision of an effective saw-set adapted for use in connection with any character of saw, one which can be conveniently operated and which will have a hammer action, enabling the teeth of the saw to be set as accurately and readily outside of the shop as at a bench within the shop.

THREAD TWISTING AND WAXING MACHINE.—A. H. Forsythe, Sarcoxie, Mo. The invention pertains particularly to improvements in machines for twisting together a plurality of threads and waxing the same for use in a leather-sewing machine, an object being to provide a machine for this purpose that will be simple in construction, positive in action, and that may be readily attached to a sewing-machine.

DRYING APPARATUS. — G. Stiff, Norwich, Conn. The invention refers particularly to improvements in vacuum-driers, the object being to provide a drier in which material to be treated may be readily placed and removed therefrom. When the trays containing material to be treated are in the chamber the door is closed, thereby forcing the trap into position and making steam-tight connections, and steam is admitted and passes through tubes into the chambers of partitions and then passes around the ends of partitions and out through exhaust tubes. This exhaust-steam passes into spaces around the vacuum-chamber, the water of condensation flowing away by its own gravity.

CAM-FINISHING MACHINE. — G. Meyer, Grünhof, near Stettin, Germany. Mr. Meyer's invention relates to a machine for finishing, with the aid of a file, cams which have been coarsely worked by a milling-machine or other machine-tool and possess such a shape as to be capable of engaging and sliding in slots with parallel faces. Such cams have an equal diameter in certain directions and are used in many machines—for instance, in sewing machines. Cams finished on this machine will be superior to those by hand, since the file is mechanically and positively guided.

COIN-DISTRIBUTER.—C. H. Hall, Fresno, Cal. The claim of the inventor as an object of his invention is the provision of a new coin-distributer which is simple in construction, not liable to easily get out of order, and arranged to distribute the assorted coins according to their size and value and in the proper sequence.

MECHANICAL MOTOR.—E. Putnam, Rossville, Ill. This improvement relates to a mechanical motor for elevating materials or for driving machinery of various sorts. It is particularly useful in connection with animal-power as contradistinguished from use in transmitting engine-power. It is particularly adapted for use in driving grain dumps and elevators, especially in case steam or other engine power is not practical or convenient.

MACHINE FOR SHARPENING AND REPAIRING DRILLS.—J. J. Brossoit, Grand Rapids, Wis. The apparatus is for operation on rock-drills, particularly the usual cruciform drills, by which to sharpen, re-shape, and otherwise repair the drills. It comprises means for mounting and moving the drill toward and from the tools of the apparatus, these tools furnishing means for reshaping the drill and acting on the edges thereof to sharpen the same. Preferably the shaping-tools are in the form of an anvil and hammer, between which the point of the drill is introduced, means being provided so as to give the drills the usual V-shaped edge.

TICKET-COLLECTING APPARATUS. — H. L. Des Anges, New York, N. Y. The invention refers to an apparatus particularly intended for use in connection with steamboat and railway systems to collect admission-tickets from the passengers as they pass aboard the train or boat. It is not, however, limited to this particular use and may be employed under various other analogous conditions. The principal object is to so construct and arrange the apparatus that fraud on the part of persons in charge will be impossible.

CHUCK.—C. O. Bergman and M. Elmer, Hastings, Mich. Among other things this invention has for an object to provide for conveniently holding the work on machines. In operation, when centering a piece of metal too large to be held in the milling-machine or shaker-chuck, two prick-punches are made upon one side of the piece and one upon the other, and three spurs are manipulated so as to enter the prick-punches and securely hold the work in place. Means are provided for securing both long and delicate adjustments.

Prime Movers and Their Accessories.

EXPLOSION-ENGINE. — R. O. LE BARON, Pontiac, Mich. The object in this case is to provide a gas, gasolene, or the like explosion-engine arranged to utilize the expansive power of the gas to the fullest advantage and to allow running the engine with the greatest economy. Mr. Le Baron does not limit himself to the number of pairs of cylinders as the same may be varied and two or more than three pairs may be used and connected with each other for producing the desired result.

DRAFT-DRIVEN GENERATOR. — W. H. JORDAN, Hays, Kan. This invention relates to engines, the inventor's more particular object being to economize the draft thereof in such manner that when the draft is excessive it may be used to operate machinery, thus utilizing a certain amount of power otherwise wasted. It is of peculiar value upon locomotives, where under certain conditions the draft requires to be frequently shut off.

ROTARY ENGINE.—J. P. BRUYÈRE, Passaic, N. J. A purpose of the inventor is to provide an effective construction of rotary engine, and one which will be economic in the use of steam. A further purpose is to so construct the engine that a piston is located in a casing, both of which parts may be employed as drivers, and wherein each is mounted to revolve relatively to the other. Another is to provide the engine with a simply-applied and readily-effective reversing mechanism and cut-off.

Railways and Their Accessories.

CONCRETE RAILWAY-TIE.—G. S. MILLER, Burlington, Vt. The purpose of the improvement is to provide an economic form of tie in which the devices for seating and securing the rails consist in box structures having chambers to receive spikes and means for removably holding the spikes in said chambers in firm clamping engagement at their heads with the flanges of the rails, it being possible to expeditiously and conveniently replace any damaged spike without disturbing the rails or an adjacent spike.

FOLDING EXTENSION-STEP. — J. S. COXEY, Aberdeen, Wash. The intention in this case is to do away with the small tool or box employed to facilitate the landing of passengers from railway-coaches at stations where there is no convenient platform and to accomplish such result by providing an auxiliary bottom step having folding or swing connection with the lower step of the usual series fixed to the platform of a coach, and to control the movements of the auxiliary steps by means of a series of levers conveniently operated through a handle member located at the platform of the coach.

VENTILATING MEDIUM FOR CARS.—C. P. BONNETT, New York, N. Y. The aim of the inventor is to provide means for ventilating cars in a thorough manner and without subjecting the occupants to drafts, and in the construction of the appliance to provide means for regulating the amount of air to be admitted, the said means being conveniently operated from the interior of the car, and further to so construct the upper portion of the car that the foul air will be sucked out from the interior and fresh admitted.

Pertaining to Recreation.

APPARATUS FOR INDICATING THE SCORES OF PLAYERS IN SUCH GAMES AS BILLIARDS OR THE LIKE.—C. S. OAKES and J. A. MANTON, Parramatta, New South Wales, Australia. The invention refers more particularly to a mechanical device for indicating the score of players in the game of billiards, and has for its object to provide a simple scoring-board which may be easily read and understood from a distance, so that the players, as well as the onlookers, may be kept advised as to the state of the game as it progresses, while at the same time it is capable of easy and accurate manipulation by the marker.

Pertaining to Vehicles.

REELING DEVICE.—C. A. HADLAND, Bennington Township, Minn. This device is for use in reeling wire and the like and is designed to be mounted upon a wagon-body, so that the wire may be reeled or unreeled as the wagon moves. The principal objects are to provide means for removably attaching the device to the body of a wagon, to provide for securing the reel in operative or in inoperative position, and for manipulating a guide for the reel, and for operating these devices conveniently from the seat.

HITCHING-WEIGHT HOLDER. — H. H. TOTHILL, Lockport, N. Y. This invention has reference to improvements in devices for supporting a horse-hitching-weight on a delivery-wagon or other vehicle, an object being to provide a supporting device of simple construction by means of which the weight when not in use may be suspended from the footboard or other portion of a vehicle in such manner as to be readily lowered to the ground or raised by a person sitting in the vehicle.

Designs.

DESIGN FOR A BUTTON-RIM. — G. E. SCHWEIG, New York, N. Y. In the present design, from the open center of the button neat and attractive scroll work radiates to the outer edge of the rim, which edge is dotted with a row of small circles, the whole giving a very clean and pretty ornamental effect.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 7075.—For makers and dealers in novelties and newly patented articles.

Inquiry No. 7076.—For manufacturers of self-propelling invalid chairs.

Inquiry No. 7077.—For dealers in colored celluloid goods, also celluloid in the crude state.

Inquiry No. 7078.—For makers of rubber goods.

Inquiry No. 7079.—For manufacturers of springs wound by a key and run for five or ten minutes.

Inquiry No. 7080.—For manufacturers of and dealers in hydraulic rams for use in shallow wells or ponds.

Inquiry No. 7081.—For makers of machinery used in manufacturing dynamite, stumping powder, etc.

Inquiry No. 7082.—For makers of ice-making machinery.

Inquiry No. 7083.—For manufacturers of small spring motors, such as used in toys and novelties.

Inquiry No. 7084.—For makers of camera fittings, as screws, etc.

Inquiry No. 7085.—Wanted, second-hand, small rail for miniature railroads.

Inquiry No. 7086.—For makers of "Buffalo" stock whips.

Inquiry No. 7087.—For makers of face masks.

Inquiry No. 7088.—For manufacturers of a game known as parlor croquet.

Inquiry No. 7089.—For manufacturers of road-making machinery, rock crushers, etc.

Inquiry No. 7090.—For makers of machinery for manufacturing wood screws.

Inquiry No. 7091.—For makers of raw rubber, such as used by makers of rubber stamps.

Inquiry No. 7092.—For dealers in gold leaf for for gilt woodwork.

Inquiry No. 7093.—For makers of painted satin, canvas or perfume boxes or bags.

Inquiry No. 7094.—For makers of town clocks.

Inquiry No. 7095.—For makers of motor canoes, motors, fire engines, or fire pumps, without horse power.

Inquiry No. 7096.—For machinery to cut metal in thin strips like tinsel.

Inquiry No. 7097.—Wanted, wholesale powdered aluminium and barium peroxide.

Inquiry No. 7098.—For the manufacturers of the Fairy Floss candy machine.

Inquiry No. 7099.—Wanted, machinery to manufacture granular effervescent salts, for druggists' use.

Inquiry No. 7100.—For an etching fluid for use with rubber dies, for making polished steel.

Inquiry No. 7101.—For makers of all kinds of hinges in large quantities, also for makers of all kinds of boxes.

Inquiry No. 7102.—For makers of gasoline motor cars for use on interurban lines (on rails).

Inquiry No. 7103.—Wanted, an apparatus for ozonizing air; with a capacity of ozonizing about 500 cubic feet of air per minute, and it is desired, if possible, to use a 3-phase alternating current of 60 cycles at whatever voltage might be best.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9699) L. F. P. says: In your highly esteemed journal I notice with interest the development of motive power from the windmill. Would you be kind enough to answer the following through your columns: Is it necessary that rudder area should be greater than blade area? If not, why would not the mill turn around on the transmission shaft? Am I not right in stating that the rudder has to hold the mill against the wind, and also against its own force, and consequently the rudder area plus its leverage must be greater than blade and power area? We will assume there is a five-horse wheel and five horse-power is being consumed through the transmission shaft. What holds the mill against the transmission shaft? If it is the rudder, does not this rudder exert the five horse-power thrust? A. Windmills are constructed in a great many ways, some transmitting the power from the windmill by crank and connecting rod motion, others by means of gears in such a way that there is no reaction from the driven shaft, tending to move the windmill out of a plane at right angles to the wind. Such windmills require very small rudders, as the force of the wind is balanced on the vanes of the mill, and the rudder is only necessary to turn the mill, so that it will always face at right angles to the direction of the wind. Where, however, the power is transmitted to a vertical shaft by means of a single pair of beveled gears, there is a reaction tending to turn the mill from the plane at right angles from the wind equal to the force tending to rotate the mill multiplied by the leverage. In such a case, the force of the wind on the rudder multiplied by its leverage must be sufficient to balance it.

(9700) K. H. L. says: Will you please give me the numbers of your recent papers that have an explanation of the Edison three-wire system of electric lighting? Also the numbers that have its history and recent application? Will you please also give me the numbers of papers that deal with the subject of electrical heating? A. We can furnish you with two papers, SUPPLEMENT Nos. 309 and 737, containing valuable articles about the Edison three-wire system. We do not know any recent application of this system. It is being very rapidly superseded by the alternating-current systems of lighting, since it cannot be used very far from the central station. The number of articles relating to electric heating is very large. We name SUPPLEMENTS 825, 1037, 1059, 1077, 1112, 1182, 1374, 1375, 1419, 1420, 1421, 1472, 1502. All papers are furnished at ten cents each. New SUPPLEMENT Catalogue sent on request.

(9701) H. B. M. asks: Is there any way that one can change an alternating current of 110 volts to 20 or 25 direct suitable to run small motor? A. Alternating current can be transformed to direct by means of a rotary transformer, wound to give any voltage desired; or a Cooper-Hewitt mercury arc converter can be used. 2. What changes would have to be necessary in a magneto generator to furnish current to operate an induction coil giving a 1-inch spark? A. The changes needed to fit a magneto to run a 1-inch induction depend upon what the magneto is. We do not think the ordinary telephone call magneto can easily be made to do this. 3. How many times does an ordinary door bell make and break with three dry batteries? A. We can only guess how many times a bell strikes a second when three dry cells are attached to the circuit. We guess three times. If you will count a bell for a quarter of a minute, you can find out if we have guessed right. 4. What is the best interrupter for induction coils? A. For small coils a vibrating interrupter is always used. For large coils a rotary interrupter is sometimes used, and sometimes an oscillating arm dipping into mercury is used.

(9702) C. C. B. asks: Will you please tell me through your paper whether the zinc tubes or cups used in making the dry battery described in the SUPPLEMENT No. 1387, August 2, 1902, on page 22225, can be used more than once, that is, can it be refilled? A. In the action of a dry cell, the electricity is produced by the solution of the zinc in the sal-ammoniac. If there are no holes eaten through the zinc when the other materials are exhausted, the zinc cup of a dry cell may be refilled and used for another charge.

(9703) J. L. W. asks: Will you kindly inform me as to the relative speed of light and electricity? A. Electricity travels in space with the speed of light. Indeed, light is simply an electromagnetic disturbance of the ether of space. In wires and through matter electricity travels with other lower velocities. See Watson's "Physics," price $3.50; Thompson's "Electricity and Matter," $1.25, or Thompson's "Elementary Electricity," price $1.50.

(9704) H. A. K. says: I have a hollow cylinder 1¼ inches diameter by 3 inches high. How many cubic inches of air will be compressed into it at 100 pounds pressure per inch? At 200, at 300, at 400, at 500? If the height of the cylinder is cut in half, how many cubic inches will it contain at the same pressures? What is the rule for finding the volume of air compressed into a given space at a given pressure? What books treat on the subject. A. Your cylinder contains 3.68 cubic feet of air at atmospheric pressure. At 100 pounds pressure it will contain 3.68 times $\frac{114.7}{14.7} = 28.8$ cubic inches. At 200 pounds per square inch it will contain 53.8 cubic inches. At 300 pounds per square inch it will contain 78.8 cubic inches. At 400 pounds per square inch it will contain 103.8 cubic inches. At 500 pounds per square inch it will contain 128.8 cubic inches of air at atmospheric pressure. If you halve the height of the cylinder, you will halve the amount of air that it will contain. The pressure of the atmosphere on an average is about 14.7 pounds per square inch. When the pressure is increased, the volume of each cubic inch of air is decreased in the same ratio that the pressure is increased above 14.7. In working these problems it is necessary to remember that pressures as ordinarily measured by gages are pressures above the atmospheric pressure. To obtain the absolute pressure or true pressure, it is necessary to add 14.7 to the pressure given by the gages, as has been done in working the examples above. We recommend and can supply you with the following book relating especially to the subject you refer to: "Compressed Air; Its Production, Uses, and Application," by Hiscox, price $5 postpaid.

(9705) L. H. N. asks: Where is the north magnetic pole now located? A. The north magnetic pole was found by Ross in 1831 to be on Boothia Felix near Hudson's Bay. This must be considered an approximate determination. It is not probable that the same point is the pole now. 2. Is it moving, and if so, in what direction and how fast? A. The pole is probably not at rest, though little can be said definitely on the point, and nothing is known as to the rate of its motion. An expedition is now engaged in making a new survey to determine the north magnetic pole. 3. How many degrees east or west of a line running north and south does the compass needle point for central lower Michigan? A. In 1902 the needle pointed 2 minutes west of true north in Michigan. In 1896 it pointed 26 minutes west of true north at your place. The line of no variation passed into Michigan almost in the center of the southern boundary of the State in 1902. 4. Is there any easy method by which a person can tell the time to within a few seconds where telegraphic service cannot be had? A. The time of day can be best determined by a sundial in the absence of the telegraph and the railroad.

(9706) O. D. asks: In the type of open-circuit battery listed in catalogues as "National No. 2," how much black oxide of manganese should be put in the porous cups with the pulverized carbon to make the cell give the best results? In mixing the sal-ammoniac solution in quantities, how much sal-ammoniac should be used for each gallon of water? A. For all sal-ammoniac cells with porous cup use granular and not pulverized peroxide of manganese and coke broken into small lumps. A mixture of equal parts may be used. For the electrolyte take from 1 to 2 pounds of sal-ammoniac to a gallon of water. A saturated solution is not desired, since any crystals left in the bottom of the jar tend to cause a deposit of crystals on the zinc, and will weaken the action of the battery.

(9707) M. A. asks: 1. Will a primary uninterrupted galvanic current pass over or through any part of the human body? The writer has failed to detect such passage with a delicate galvanometer, even with twelve or fifteen Samson cells. A. If your galvanometer is sensitive enough, there is no difficulty in detecting a current which passes through the human body. Connect the wires to a piece of zinc and one of carbon or copper. Dip the hands in water, and take the zinc in one hand and the copper in the other hand. The galvanometer will show a deflection, due to a current produced by the hands. So will it if two pieces of zinc were used as above. Let several persons wet their hands in clear water and join hands, the outer persons taking the zinc and carbon, as above, and the galvanometer will show a sensible deflection. You do not need a number of cells. You need a more sensitive galvanometer. 2. If a mixture of gas and air confined in a tight cylinder was fired by electric spark or otherwise, a disastrous explosion would be the result. Why does not the same occur when firing the mixture in a gas engine cylinder? A. If a quantity of gas and air mixed are exploded in a cylinder

strong enough to withstand the explosion, the cylinder will not break. This is what is done in a gas engine. If the cylinder is not strong enough, it breaks. The gas-engine cylinder is strong enough.

(9708) W. G. asks: Could you tell me how I can determine the positive and negative side of a live wire, not tracing it to the station or to the lamp or motor, etc.? Is it possible? A. The direction of flow of an electric current in a wire may be told by a compass needle placed so that the current flows along the needle, that is, lengthwise of the needle as the needle stands north and south. In this case the needle will be turned more or less across the wire by the magnetic action of the current. To determine the direction of the current, hold the open right hand over or under the conducting wire, but so that the wire is between the hand and the needle, so that the palm of the hand is toward the needle, and so that the thumb is extended in the direction in which the north or marked end of the needle is deflected; the fingers will point in the direction of the current.

(9709) E. B. E. writes: In your paper for April 15 is given a rule for the approximate extraction of square root. The first part of the rule is a well-known method, and applies quite generally and not merely to numbers within the limits given. The second part seems rather obscure, and is not easy to remember. The best rule is perhaps that given by Charles Hutton, a prominent mathematician of the eighteenth century:

$$\sqrt{N} = \frac{3N + r^2}{N + 3r^2} \times r \text{ approximately.}$$

(Where r is an approx. root.)

Example: Let $N = 271$, $r = 16$

$$\sqrt{271} = \frac{3 \times 271 + 256}{271 + 768} \times 16 = 16.4620 \text{ approx.}$$

True value 16.4621

The corresponding formula for cube root is:

$$\sqrt[3]{N} = \frac{2N + r^3}{N + 2r^3} \times r$$

Example: Let $N = 271$, $r = 6$

$$\sqrt[3]{271} = \frac{542 + 216}{271 + 432} \times 6 = 6.469$$

True value 6.471

A. The rule given above is far more simple than the one formerly printed in this column. If one needs an approximation for the square root, we should advise that this rule be copied and employed.

(9710) E. R. MacP. says: 1. *Re* inquiry 9615, under date April 15: I quite follow your reply, but I think that your correspondent must have been thinking of the influence of wind on a bullet; for it is a well-known fact that when the wind is blowing in the same direction as a bullet (or any projectile) it has a tendency to elevate the bullet above its usual trajectory. And just the reverse happens when the wind is against the bullet. 2. What is the formula for measuring rain? It runs something like this, I think: "So many square inches of catchment area require so many cubic inches in order to measure one inch of rain." A. To measure the fall of rain in cubic inches, it is necessary to have as many cubic inches of water as there are square inches in the "catchment area." A better way of determining the depth of rainfall is to use a rain gage. The United States Weather Bureau rain gage is a metal dish about 8 inches in diameter at the top. The rim is of heavy copper turned to a sharp edge. This opens below into a narrow dish, whose sectional area is exactly one-tenth of the area of the upper dish, and whose depth is 20 inches. It is obvious that the water will be ten times as deep in the lower dish as it would be if retained in the upper dish. The rain caught is measured in the lower dish, and the depth divided by ten gives the rainfall. Two inches of rain would fill the lower dish. 3. Is it possible to calculate an "angle of safety" for a circular cycle track? For instance, I want to build a circular track 50 feet in diameter. What would be the angle of safety for that? When I use the term "angle of safety," I mean the greatest possible angle that the track can be inclined without the rider being thrown off, granting of course that he is riding at a high rate of speed—say 15 or 20 miles an hour. A. The "angle of safety," as you term the angle of inclination of a track on which there would be no tendency for a bicycle to slow in going around a corner, will vary with the speed of the rider and also with the radius of the track. If the track is W feet wide, the proper elevation (measured in feet) at the outside can be found from the following formula:

$$\text{Elevation} = W \times \frac{z^2}{32\,R}$$

Where z^2 = the velocity of feet per second, and R = the radius of the track in feet.

(9711) T. A. B. asks: There are two grounded telephone lines—entirely separate—running parallel at a distance of about 100 to 150 feet apart. A conversation on one line may be distinctly heard on the other. One line is private, and the other runs to a switchboard. A. Wherever two telephone lines interfere with each other, the cause is always the induction of the current in one line upon the other line. It can be remedied by the use of a metallic circuit, with twisted or crossed wires.

(9712) E. M. B. says: If an Archimedean screw is placed so that the opening in the lower end is under water during its entire revolution, will the screw raise a continuous stream, or will the flow from the upper end be intermittent, and why? A. If an Archimedean screw is placed so that the opening in the lower end is under water during its entire revolution, the flow from the upper end will be continuous, provided the conditions are such that there is any flow at all, if the pitch of the screw is uniform, and the speed of rotation is uniform; otherwise, it will vary. If the angle of the screw is too great, or if the pitch of the screw is too great, or if the speed of rotation is insufficient, there will be no flow of water at all.

(9713) F. De M. asks: About what is the resistance of the dry cell in common use, standard size 2½ x 6¾ round, such as the Mesco, Columbia, New Standard, etc.? A. The internal resistance of dry cells is not constant, and must vary during the life of the cell. Since the E.M.F. of these cells is not high, the internal resistance should be low. Some makers give the resistance of their cells as low as 0.15 to 0.25 ohm. This quantity is difficult of measurement because these cells polarize very rapidly, and the current changes for that reason.

(9714) W. F. W. asks: 1. There is a widely prevalent belief that a razor by being kept in constant use loses its good shaving qualities, and that by allowing it to "rest" for a while unused it will recover its original shaving qualities. Has that belief any real foundation? If so, please explain the cause for such remarkable metallic peculiarities. A. The only suggestion we can give you as a foundation for the belief that allowing a razor to rest would improve its shaving qualities is as follows: The literal *edge* of a razor is only of microscopic thickness. This edge, when exposed to the atmosphere, oxidizes rapidly. The tendency of "rest" therefore would be to produce a jagged edge, which when very much magnified would look somewhat like the edge of a saw, and it is well known that a rough edge, when keen, will cut better than an edge which is too smooth and uniform. We believe, however, in spite of the facts that we have just described, which may have improved the cutting qualities of razors in a few exceptional instances, that imagination, which plays all kinds of freaks with things too small to be seen, is the real foundation for the belief to which you refer. 2. Why do blacksmiths pour water upon the burning coals in the forge? I have never been able to get an entirely satisfactory explanation from the blacksmiths themselves. A. Blacksmiths pour water on their forges in order to control the size of their fires. As a rule, they wish to heat their iron only for a limited distance along the bar, and therefore must control the diameter of their fire. The water also serves two other useful purposes. It tends to make the coal cake in such a way as to be nearly impervious to the blast. Thus a nearly air-tight ring or chimney may be formed around a fire, which will help to concentrate the air from the blast at the point where it is most needed. This caking of the coal helps in the process of transforming blacksmith's coal into coke, in which condition it forms a better fuel and produces a better fire than could be obtained from green coal. From this last reason, blacksmiths will often be found wetting their coal to aid in the process of manufacturing coke, when wetting the fire would not be necessary for the particular job they have at hand. 3. What are wash drawings, and how are they made? A. "Wash drawings" are ordinary India-ink drawings on paper which have been tinted with water-color paint, to make them more accurately represent in appearance the object for which they are made. Architects' drawings are often prepared in this way, and the practice was common with engineers a generation ago. 4. Please explain how the "parallax stereogram" pictures were made which were exhibited at the St. Louis Exposition. Portions of the objects projected forward, appearing to be in front of the frame, and other portions appeared to be considerably farther back. A. Parallax stereograms are constructed of sets of lines, so that each set forms its part of the scene represented. Some of the dailies have been issuing these pictures as supplements, so that now they are very common.

(9715) H. H. S. asks: Please let me know through the SCIENTIFIC AMERICAN how to find the gage of wire. In other words, of a certain piece of wire of known diameter in fractions of an inch, what is its number? A. There is no way of finding the gage of a wire except by the use of a wire table, which gives the number of a wire and its diameter in thousandths of an inch. Nor is a wire known unless the name of the gage by which it is measured is expressed as B. & S., Stubs, or some other. The whole matter of gages is in a bad condition, and some unification should be made. The best would be to denote a wire by its diameter.

(9716) J. McL. asks: In SUPPLEMENT No. 1215, page 19474, you have an article advising the use of dilute phosphoric acid in water to ward off old age, etc. I have seen a warning in some book to not use more than 15 drops of dilute acid in water three times a day. I believe there is sound reason in the article referred to, and would ask if it would not be a good idea to print same in SCIENTIFIC AMERICAN soon, with the warning to not use more than 15 drops of the acid in water three times a day. What would be the effect on the teeth of using same, or if any hollow teeth were present would it affect the jawbone? A. Phosphoric acid is a very excellent tonic, and if one's physician prescribes it, we should certainly advise you to take it. We should not advise anyone to prescribe for himself even a most excellent remedy. Let medicines alone till some one outside of yourself orders them. That is good advice for anything beyond simple household remedies, such as catnip tea and the like, which do no harm when they do no good. When phosphoric acid is to be taken, it is usually given in the form of a phosphate or phosphite. The soda fountain drink orange phosphate, so popular of late, is simply an acid phosphate with orange syrup added. As to the action upon the teeth we cannot pronounce, since the doctors have not decided just what causes the necrosis of the bone in the case of workers in match factories. We cannot advise one whether to study mechanical drawing or photo-engraving. The man should study the one he likes best and can do the work best in, or the one which is nearest his hand. All sorts of wages are paid in both trades, and a good man can get a living at either, though he will not get rich at either working on a salary.

NEW BOOKS, ETC.

CAMS AND THE PRINCIPLES OF THEIR CONSTRUCTION. By George Jepson. Cambridge, Mass.: The University Press, 1905. 8vo.; pp. 59.

Cams are one of the most important parts of nearly all machinery; and a clear and concise work on their design and construction will be found valuable to all mechanical engineers. This little volume is such a work, and we heartily recommend it to the engineering fraternity. It is largely filled with exceedingly clear drawings of different kinds of cams used for various purposes, and there are several half-tone plates of cams on different machines.

CELLULOSE, CELLULOSE PRODUCTS, AND ARTIFICIAL RUBBER. By Dr. Joseph Bersch. Translated from the German by William T. Brannt, Editor of "The Techno-Chemical Receipt Book." Philadelphia: Henry Carey Baird & Co., 1904. 8vo.; pp. 345. Price, $3.

This work is a very complete treatise on that most useful industrial material, cellulose. Cellulose, as is well known, is used in many ways, its use extending from the preparation of nitro-compounds to the manufacture of artificial silk and distillation of alcohol. All these uses are gone into and fully described in the present volume. The author first tells how cellulose is prepared from wood or straw, and how parchment is manufactured from it. He afterward describes the methods of obtaining sugar, alcohol, and oxalic acid from this substance. Later on in the work he discusses the production of viscose, the nitro-celluloses, and cellulose esters, artificial silk, celluloid, rubber substitutes, oil rubber, and factis. The work is very complete, and will be found of great value to all who wish to gain a knowledge of the uses and nature of this substance.

FLORA AND FAUNA OF THE BLOOD. By Henry G. Graham, M.D. Chicago.

This is a very interesting little pamphlet, the result of six years of hard labor, descriptive of the infusoria contained in human blood. It is illustrated with two colored plates, showing these microscopic animals as they appear under varying conditions. The book is well worth the perusal of all interested in the wonders of the human body. It is written in a popular manner, and may be understandingly read by any person of ordinary intelligence.

STAIR BUILDING MADE EASY. By Fred T. Hodgson. New York: The Industrial Publication Company, 1904. 12mo.; pp. 160. Price, $1.

The third edition of this small volume will be found very helpful by all young carpenters, and even by those of greater experience in the building of stairs and stairways. It gives a full and complete description of all kinds of staircases, and instructions for designing and erecting the same. It is fully illustrated with over 100 engravings, and is provided with a glossary and index, which make the information it contains easily obtainable.

MACHINE TOOLS AND WORKSHOP PRACTICE FOR ENGINEERING STUDENTS AND APPRENTICES. By Alfred Parr. New York: Longmans, Green & Co., 1905. 8vo.; pp. 444; ill., 550. Price, $4.

The aim of this textbook is to explain the construction and use of machine tools in a connected form. The book covers a large range of subjects, and will be found especially helpful to the practical worker, as it will enable him to study the action of the machine tools he uses, and give him hints on how best to do the various kinds of work which these tools are calculated to perform. The book contains, among its many chapters, several on Measurement; Turret Lathes; Grinding; and Milling, which have been prepared and illustrated in great detail, on account of their importance to the student and practical worker. The illustrations are both in half-tone and line cuts. They are numerous, and will aid greatly in instructing the student.

LLOYD'S REGISTER OF AMERICAN YACHTS, 1905. Published from New York office of Lloyd's Register of Shipping, 15 Whitehall Street, New York. Pp. 542, colored plates 42. Price, $7.50.

With the opening of the yachting season comes the new volume of the American Yacht Register for 1905, published by Lloyd's Register of Shipping. Though only in its third season, this book is already well known in all parts of the United States and Canada as the standard work of reference for yachtsmen.

The Register is a book of 542 pages, with 59 colored plates of club burgees, national ensigns, and owners' private signals, the latter to the number of 1,440. The total number of yachts listed is 3,389, of which 2,130 are sailing craft and 1,259 are propelled by steam or some other power. The tendency of the times is shown by the fact that while but a year ago the sailing yachts made 67 per cent of the total, this year they make but 62 per cent.

Among the power yachts the new gasoline cruisers in all sizes from 30 to 80 feet figure conspicuously, this type of craft being deservedly popular from its great utility, its adaptability to all waters, and the comparatively low cost of running.

In addition to the main list of yachts, giving the most complete particulars of hulls and engines, there are lists of signal letters, of former names of yachts, of builders and designers of the United States and Canada, and a very complete list of over 3,100 yacht owners, with addresses and clubs, as well as the yachts owned by each.

OUTLINE OF INDUSTRIAL CHEMISTRY. A textbook for students. By Frank Hall Thorp, Ph.D., Assistant Professor of Industrial Chemistry in the Massachusetts Institute of Technology. Second edition, revised and enlarged, and including a chapter on Metallurgy by Charles D. Demond S.B. New York: The Macmillan Company, 1905; 8vo., pp. 618. Price, $3.50.

Prof. Thorp's outline of industrial chemistry has been used more or less constantly by the Editor of this journal ever since its publication in 1898. The practical use to which the volume has been put during those seven years has enabled him to form a more just estimate of its technical value than can possibly be attained through the cursory reading which is usually alloted by the reviewer to a newly-published volume. The work has proved itself an excellent handbook of ready reference on industrial chemistry, and its excellent references to bibliographies at the ends of divisions have more than once proven of value. In this new edition, Prof. Thorp has included an account of the more important advances made in the chemical industries during the last seven years, and has therefore considerably improved the technical value of his volume. Mr. Charles Demond's elementary chapters on metallurgy constitute a feature which, as far as we know, is new in textbooks of industrial chemistry, but which we venture to state is likely to be found in them ere long. This metallurgical review, although necessarily brief, nevertheless gives one a very good idea of the elementary chemical principles that underlie most modern metallurgical processes.

DUALITY OF THOUGHT AND LANGUAGE. An Outline of Original Research. By Emil Sutro. New York: The Physio-Psychic Society, 1904. 12mo.; pp. 300. Price, $1.50.

Starting with Gladstone's utterance, "The scientific investigation of the spiritual is the most important subject before the public today," the author endeavors to prove the supremacy of spirituality over matter, in man. His theories, from our present-day standpoint, are nothing if not peculiar, but he is nearly always interesting, and at times helpful and inspiring.

LECTURE NOTES ON SOME OF THE BUSINESS FEATURES OF ENGINEERING PRACTICE. By Alex C. Humphreys. Published by the Department of Business Engineering of Stevens Institute of Technology, 1905. 8vo.; pp. 187.

This book has been written by Prof. Humphreys with a view to aiding students under his tuition by giving them a *résumé* of the lectures delivered in the course on business engineering. All the matter included in the course is not found in this volume, but that which is most difficult to comprehend is given, and will be found of great aid to the student. The book also contains notes on the law of contracts by Howard E. White, Esq., and the Commencement address delivered by Walter C. Kerr to the Class of 1904.

STEAM PIPES: THEIR DESIGN AND CONSTRUCTION. By William H. Booth. New York: The Norman W. Henley Publishing Company, 1905. 8vo.; pp. 187. Price, $2.

This book forms a practical treatise on the principles of steam conveyance, and the means and materials employed in practice to secure economy, efficiency, and safety. The book is well illustrated, and gives many useful ideas with regard to the making of pipe joints, expansion offsets, flexible joints, and self-contained sliding joints for taking up the expansion of long pipes. The chapters on the flow of steam and expansion of pipes will be found extremely useful to all steam fitters. The pressure strength of pipes and the method of hanging them, as well as valves and bypasses of all kinds, flanged joints and their proper

proportions, exhaust heads and separators, etc., are well illustrated and described. A valuable chapter to the large steam user is the one on superheated steam and the saving of steam by insulation. The loss of heat in thermal units from covered and uncovered steam pipes is given in suitable comparison tables. The book will be found extremely useful to all interested in steam-pipe construction.

A TREATISE ON ROCKS, ROCK WEATHERING, AND SOILS. By George P. Merrill. New York: The Macmillan Company, 1904. 8vo.; pp. 411. Price, $4.

Although the origin, structure, and mineral composition of rocks, particularly those of erupted varieties, have received particular attention from petrologists since the introduction of the microscope into petrographic work, there has, however, been very little time devoted to the study of rocks in a weathered condition. In many cases where chemical analyses have been made, the chemists have disregarded the physical and mineralogical nature of the material analyzed. Other workers have studied the physical properties of decayed rocks, i. e. soils, but have, in turn, disregarded their mineral and chemical nature. The author has endeavored to bring together results obtained by these various workers—results which, it is believed, will be to the mutual benefit of all concerned. The state of comminution reached by rocks during the process of long-continued decay, and the amount of leaching such have undergone, are of as much practical interest to the agriculturist as they are of theoretical interest to the geologist. A very general scheme of classification is adopted in the present preliminary volume, as the author desired to introduce into it as few new terms as possible. The analyses given were made by the author himself from materials which he collected, and which, he believes, are truly representative samples of rock, concerning the lithological identity of which there can be no doubt. The reason that so little use has been made of other analyses is that information is generally lacking relative to the mutual association of fresh and decomposed materials and the mineralogical and physical nature of the residual product. The book is divided into five parts, as follows: The Constituents, Physical and Chemical Properties, and Mode of Occurrence of Rock; the Kinds of Rocks; the Weathering of Rocks; the Transportation and Redisposition of Rock Débris; and the Regolith. Some twenty-five full page plates, in addition to nearly half a hundred other figures, completely illustrate the work.

THE BERLIN-ZOSSEN ELECTRIC RAILWAY TESTS OF 1903. Translated from the German by Franz Welz, E.E. With an Introduction Discussing the General Subject of Train Resistance by Louis Bell, PhD. New York: McGraw Publishing Company, 1905. 4to.; pp. 100. Price, $3.

This is a full and complete report of the test runs made on the Berlin-Zossen experimental railroad from September to November, inclusive, 1903. These tests occupy a unique place in the history of modern engineering, for they represent a very thorough and highly successful effort at solving the greatest problem of twentieth century transportation, viz., the application of electric traction to greatly increased railway speed. The introduction by Mr. Bell sums up the results that were attained, while the rest of the volume deals with the preparatory work that was gone through with before the tests were made, and the results of the tests as to the time required for starting and stopping, the air and train resistance, the power consumption, the behavior of the car during service, and the behavior of the new roadbed during the tests. The book has an appendix concerning a high-speed railway from Berlin to Hamburg. It contains numerous diagrams and test charts. It is a thorough *résumé* of the tests that were made.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending July 18, 1905

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acid, monoglycol ester of salicylic, F. Hofmann 794,982
Amusement apparatus, C. Alonso-Perez.... 795,087
Animal trap, E. Firmhaber.... 794,856
Automatic gate, A. Noe.... 795,162
Automobile attachment, E. G. Nicewaner 795,054
Awning, C. W. Linder.... 794,807
Awning, frameless, S. C. Crowe.... 795,105
Baling press, horse power, M. C. Nixon.. 794,811
Ball or bullet, H. C. Aspinwall.... 795,088
Ballot box, C. B. Gilmore.... 795,114
Basket, M. L. Porter.... 794,883
Bearing, compensating knob, H. G. Voight. 794,757
Bed bottom, H. R. Hervey.... 795,223
Bed, invalid's, E. A. Hall.... 794,978
Bed, sofa, Cumla & Fridstrom.... 795,199
Bedstead, A. A. Nees.... 795,153
Belt tightener, A. L. Herkenhoff.... 795,038
Binder cleat, J. R. Barrett.... 794,916
Binder or loose sheet holder, temporary, H. F. Bushong 794,778
Blast furnace, N. M. Langdon.... 795,139
Bobbin and spindle connector, Roney & Rae 795,008
Boiler baffle, steam, J. S. Hammerslough. 794,711
Boiler superheater, steam, Cole & Oatley. 795,260

Boilers, device for automatically filling steam, T. M. Wilkins 794,906
Book carriage, S. A. Marsh.... 794,809
Book stack, sheet metal, P. M. Wege... 794,759
Books open, device for holding, W. Maguire 795,048
Bottle, non-refillable, R. Dunne.... 794,929
Bottle, non-refillable, E. P. Dole.... 795,030
Bottle valve guard, non-refillable, E. P. Dole 795,029
Bottles, device for preventing the refilling of, M. J. Segal 795,173
Bottles, weighted ball for non-refillable, J. S. Wright 794,830
Bottling apparatus, liquid, C. A. Hopkins. 795,040
Bracket, J. E. Campbell.... 795,101
Brake, C. E. F. Burnley.... 795,099
Braking device, C. L. Horack.... 794,802
Breech mechanism, S. A. Hammar.... 795,221
Brick press, V. Then 794,822
Briquetting machine, G. W. Rigby.... 795,007
Brush with bristles movable in all directions, H. Pollmann 795,062
Building block, W. J. Sterling.... 795,177
Bung, H. Schmidt 795,237
Button, tufting, A. Freschl 794,973
Cake mixer, A. A. Warner.... 795,082
Calendar, H. E. Shedd 795,009
Camera plate holder, photographic, R. J. & J. A. London 794,992
Cane mill, G. M. Lear 794,722
Cane, transformable walking, J. Adamson. 794,833
Car brake, street, J. Hastreiter.... 795,035
Car clamping device for car unloading machinery, G. E. Titcomb 795,012
Car coupling, W. F. Richards.... 794,885
Car coupling, F. H. Norwood.... 795,231
Car draft and buffing structure, railway, W. F. Richards.... 794,887
Car haul, F. V. Hetzel 795,124
Cars or the like, armored protector for, J. J. Hutto 794,804
Cars, power shovel for loading box, J. Olson 794,946
Carbon tetrachlorid, making, J. L. Danziger 794,789
Carbon tetrachlorid, purifying, J. L. Danziger 794,970
Carbureter, E. B. & L. S. Cushman.... 794,927
Carbureter, G. Hoslon 794,938
Carbureter, Schaaf & Lacy.... 794,951
Carbureting machine, S. S. Poole.... 795,233
Castrating, docking, and earmarking sheep, cattle, or horses, instrument for, J. Dignan 795,205
Chair, H. C. Bunnell 794,777
Check or coin controlled apparatus, J. L. McCullough 795,052
Cheese cutter, B. Blood 794,921
Chuck, Potter & Johnston 795,234
Chute, coal, A. L. Koch.... 795,043
Circuit breakers, time limit controller for, E. M. Hewlett 794,981
Cistern or well cleaner, L. Leggett.... 794,806
Clock, coin freed alarm, Krause & Grudzinski 794,718
Clothes drier, B. B. Moss 795,051
Clothes line clamp, Pahl & Rahn.... 794,812
Clothes line fastener, E. Minetti 794,728
Clothes pin, S. C. Whitlow 794,945
Clutch, friction, A. L. Herkenhoff.... 795,037
Coal tipple, J. Hughes.... 794,803
Cock, stop or waste, G. M. Page.... 795,005
Coffee urn, C. A. Robertson.... 794,949
Coiffure retainer comb, G. L. Winn.... 794,928
Colter fastener, plow, P. W. McFall.... 794,731
Comb. See Coiffure retainer comb.
Compasses, J. Pilsatneeks 795,061
Compo board, assembling machine for forming a continuous, G. S. Mayhew.... 794,874
Compo board, making, G. S. Mayhew.... 794,873
Concrete conduit trimming machine, J. Kohler 794,989
Controller, double, C. I. Earll.... 794,792
Converter, Baggaley & Lindquist.... 795,092
Conveyer, I. Peabody 794,736
Conveyer chain guide, C. Piez.... 795,166
Conveying apparatus, A. McDougall 794,877
Copy holder, J. Cook 795,104
Counter guard, J. S. Auerbach.... 795,090
Cover, receptacle, G. D. Glaser.... 794,708
Cultivator, W. Sobey 794,751
Cultivator, W. S. Graham.... 794,796
Current collecting shoe, W. M. Brown.... 795,247
Current motor, alternating, M. Milch 794,995
Curtain pole, J. Hoffmann 795,039
Curtain pole and fitting, E. B. Orr.... 794,947
Curtains, etc., fastening for, F. J. Henry 795,122
Cuspidor, H. J. Rehorn.... 795,063
Dam, L. E. Rice 794,813
Denture, artificial upper, L. L. White.... 795,084
Disintegrator, W. Cox 794,785
Display card, A. Bauer.... 794,841
Display rack, chair, H. J. Montgomery.. 795,162
Display stand, shoe, Harding & Biebl.... 795,117
Door fly scarer attachment, screen, E. J. Gould 794,860
Door frame for air tight doors, S. P. Stevenson 794,953
Door, grain, Strong & Uhlin.... 794,819
Door hanger, T. Leonard 795,229
Door hanger, sliding, H. J. Weiss.... 795,241
Door opening or closing device, automatic, L. Ives 795,225
Dough brakes, revoluble table for, A. C. Wank 795,081
Drafting table, G. Ring 795,065
Dredge box, C. M. Symonds 794,958
Drill spindle, Henry & Wright.... 795,123
Drilling rigs, steam motor for operating tools in, F. S. Barkelew.... 795,017
Drinking fountain, J. F. Bennington, et al. 794,844
Driving mechanism, C. M. Armstead.... 795,244
Drum, G. Harris 794,855
Drum mill, R. Beneke 794,843
Dye and making same, bisulfite compound of a tetrazo, A. Otto 795,058
Dynamo support, W. F. Richards.... 794,886
Electric battery, F. J. Kamperdyk.... 794,864
Electric brake, W. G. Price.... 795,170
Electric cable soldering nipple, H. E. Procunier 794,742
Electric light fitting, J. G. Irving.... 795,131
Electric machine, dynamo, F. A. Mott.... 794,998
Electric switch, M. Guett 794,935
Electrical switch and operating mechanism therefor, Richards & Turbayne.... 795,235
Electrode, arc light, F. O. Vogel.... 794,902
Elevator safety device, R. H. Gaylord.... 795,112
Engine controlling mechanism, explosive, J. F. Merkel 794,727
Engine sparking igniter gear, explosive, E. Westman 794,826
Engines, drill striking mechanism for rock drilling, L. Durkee.... 794,930
Envelop, J. W. Knebler 794,720
Evener, horse, J. J. Larson.... 795,140
Exhaust mechanism, variable, C. L. Pagenhart 794,881
Extension table, J. W. Lindow.... 794,990
Eyeglasses, L. F. Adt 794,767
Eyeglasses, G. A. Stiles 795,178
Eyeglasses, etc., lens holder for, G. H. Winslow 794,829
Eyelet, shoe, J. A. Baker.... 794,838
Eyelets with flexible material, method of and apparatus for covering, P. R. Glass 795,033
Faucet, lock, C. C. Connell.... 795,027
Feed water heater, T. Suzuki 794,821
Fence, folding wire, W. C. Gay.... 794,933
Fence post, Pierce & Williamson.... 794,739
Fence post, G. E. Blaine 794,845
File, bill, G. H. Maurer 794,993, 794,994
Filing device, A. C. Wiechers.... 794,827
Filter and cleaner, L. E. Rogers.... 795,066
Filter, water, M. N. Lynn.... 795,047
Filtering apparatus, water, J. C. Barker.. 794,840
Fire apparatus, S. A. A. Stenberg.... 795,176
Fire escape, portable, D. E. Landis.... 794,721
Fish handling apparatus, A. R. Rogers.... 794,890
Flanging machine, J. H. Vanderslice.... 795,180
Flower holder, C. E. H. Jacoby.... 794,939
Fluid brake, R. D. Whiting.... 795,085
Flushing machine, street, L. F. Ottofy.. 795,059
Food product preparing apparatus, A. T. Jones 794,940
Food products, preparing, A. T. Jones.... 794,941
Footwear, C. T. Adams 794,832
Formaldehyde candle, Bauer & Hollister... 794,771
Foundation, H. Ericsson 794,971
Fountain. See Drinking fountain.
Friction device, G. Westinghouse 794,761
Friction top can, E. W. Carnes.... 795,102

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Packing, A. B. Schier 794,892
Packing, G. M. Kneuper 794,987
Packing, J. H. Bricker 795,098
Paint composition, R. H. Goddin 795,116
Pan. See Vacuum pan.
Pants and garter attachment, A. F. & S. F. Stein 794,894
Pants with garter attaching device, knee, A. F. & S. F. Stein 794,895
Paper articles, machine for making, F. J. Motz 795,153
Paper bag machine, W. A. Lorenz 795,046
Paper forming and drying machine, G. W. Nistle 795,055
Paper or other fabrics, reeling machine for, W. H. Waldron 795,079
Parallel lines, protective system for, L. Wilson 795,182
Pavements, wooden block for, F. J. Warren 794,758
Pen, fountain, T. P. Ambrose 794,836
Pen, reservoir, W. W. Sanford 794,814
Perambulator, mail cart, or the like, A. C. Barratt 795,188
Phonograph repeating attachment, E. L. Crabb 794,786
Pianos, safes, etc., hoist for, R. M. Hill .. 794,712
Pillow, pneumatic, L. F. Doellinger 795,108
Pitman connection, G. H. Ellis 794,793
Plate and attaching device therefor, W. D. Williams 795,181
Plug and receptacle, H. R. Sargent 795,067
Portable rack, L. A. Friend 795,111
Poultry picking implement, A. Weiler 795,013
Power transmitting mechanism, T. L. & T. J. Sturtevant 794,899
Power transmitting mechanism, A. L. Herkenhoff 795,036
Preserve can, H. Bohm 794,848
Printing plates, means for locking, Taylor & Hackett 794,959
Printing surface cleaning composition, F. Forster 795,215
Printing surfaces, cleaning, F. Forster 795,216
Propeller, J. D. Fullerton 794,932
Propeller, J. Huber 794,984
Pulp molding machine, G. R. Ward 794,903
Pump, mercury, S. E. Flichtner 794,707
Pump piston, R. Addison 794,834
Pump platform, P. M. Wolf 794,764
Puzzle, C. D. H. Blakeney 794,919
Pyrotechnical grasshopper, E. H. Wagner .. 794,824
Rack, H. F. Schauwecker 795,068
Radiator, sheet metal, W. R. Kinnear 794,805
Rail brake, M. Hattery 794,862
Rail joint, R. H. Ireland 794,715
Rail joint, Johnston & Dill 795,042
Rails in situ, portable apparatus for dressing the surfaces of, Woods & Gilbert. 795,184
Railway brake apparatus, G. T. & L. Woods 795,243
Railway gate, A. Berg 795,022
Railway rail, E. F. Krell 794,719
Railway rail, A. A. Strom ...... 794,954 to 794,956
Railway rail brace, H. H. Sponenburg, 795,010, 795,011
Railway rail joint, W. A. Zelch 794,915
Railway switch mechanism, H. B. Nichols, 795,157 to 795,159
Railway tie, A. W. Yocum 795,185
Railway ties, lifting jack for spiking, G. Comi 795,195
Ratchet wheel mechanism, A. Benoit, et al. 795,095
Razor, C. L. Girard 795,115
Razor blade holder, safety, L. Heckel 794,798
Razor, safety, L. B. Gaylor 794,934
Reaper and mower, T. R. Vizard 795,078
Refrigerating apparatus, R. Whitaker, 795,014, 795,015
Rein holder, G. E. Bundick 794,776
Retaining ring, M. C. Neuner 794,733
Retort discharging apparatus, L. Degrand. 795,202
Revolvers or other firearms, application of electric lights to, E. C. I. Cailliez 794,924
Rheostat, J. W. Howell 794,983
Rheostat, automatic, C. J. Sturgeon 794,820
Ring. See Retaining ring.
Roasting furnace, J. A. Anker, et al 794,837
Rock drill, G. S. Power 795,169
Rock drilling machinery, apparatus for allaying dust in connection with, W. C. Stephens 794,752
Rocking chair attachment, E. E. Motter .. 794,999
Rope clamp, J. McKenney 794,732
Rose or escutcheon plate, compensating, Caley & Voight 794,779
Rotary engine, H. M. Lofton 794,723
Rotary engine, D. D. Hardy 795,118
Rotary engine, J. R. Lewis 795,142
Rug stiffening device, F. E. Kindgen 794,717
Ruling machine delivery table, Peckham & Hyde 795,164
Sash holder, J. W. Wynn 794,913
Saw filing machine, C. H. Slack 794,750
Saw sharpener, J. H. Ennis 794,855
Scaffold, Conover & Blair 795,196
Screw bolts, etc., ratchet spanner for, F. W. Schroeder 794,952
Scrubbing machine, J. B. Slattery 794,817
Seal, bottle, E. J. Brooks 794,849
Sealing machine, bottle, A. A. Wood 794,965
Seed cleaning machine hopper, J. Harris .. 794,936
Seed tester, S. Van Bruggen 794,756
Separator, Rowland & Longmore 794,747
Serrating machine, R. F. Massa 794,810
Sewing machine feeding mechanism, H. C. Miller 795,150
Sewing machine, filler sack, R. H. Moore 794,875
Shade holder, window, J. M. Glickman 794,976
Shade holding device, C. L. Hopkins 794,937
Shaft, crank, Cole & Stothoff 794,783
Sharpener, knife or scissors, D. B. Donaldson 794,854
Sharpening shears or other edged tools, combined holder and guide for, P. Hawkinson 794,797
Sheet metal can or the like, F. C. B. Page 794,880
Shoe form, pneumatic adjustable, C. D. Gaunt 795,217
Shoes, gloves, or the like, fastening for, E. P. Harlow 795,119
Shooting gallery, W. J. Bowerman 794,775
Shutter fastener, W. A. Jordan 795,135
Sign, changeable, F. M. Stamback 795,074
Signal system, safety, F. V. King 795,137
Signaling system, block, H. M. Coulter .. 794,784
Signaling system, block, J. O. Bohannon .. 795,190
Silvering table, G. Glaudel 794,858
Slag furnace, O. S. Garretson 795,032
Slag heated boiler, R. Baggaley 795,245
Slag settling apparatus, H. V. Pearce 795,163
Sleigh bunker, non-binding, D. Halstead .. 794,861
Slot switch, J. H. Pflieger 795,232
Smelting furnace, zinc, E. C. Hegeler 794,799
Snap hook, J. A. Peek 795,006
Soldering protective apparatus, self, F. B. Cook 795,197
Sower, fertilizer, J. B. & C. B. Ebling .. 795,031
Sponge, fountain, B. Fanning 795,211
Squares, rafter attachment for steel, M. Nicholls 795,160
Stacker, hay, W. E. Waller 794,825
Stacker, straw, W. E. Witt 794,763
Stackers, hay retaining device for, J. O. McCreery 795,154
Stairway, F. A. Winslow 794,908
Stamp, hand, B. B. Hill 794,800
Steam generator, W. D. Hoxie 794,713
Steam or hot water boiler, J. B. Bernhard. 794,774
Steps, device for fixing wooden banisters to stone, C. von Lom 795,143
Stirrup, safety, W. W. Markley 795,050
Stone polishing wheel, R. C. George 794,974
Stones, etc., and transporting same, machine for lifting, T. Trudeau 794,961
Store front, F. W. von Oven 795,004
Stove, heating, J. A. Jensen 795,226
Stove safety device, gas, R. H. Watkins .. 794,904
Stove, self-regulating, R. E. O. Suchier .. 794,900
Stovepipes or other articles, device for cleaning, H. C. Krentler 795,227
Stump or rock extractor, W. H. Wright .. 794,912
Sun dial, A. C. Crehore 794,787
Swing, T. H. Barger 795,094
Swivel hook, E. J. Haverly 794,979
Tank. See Glass tank.
Tanning substances, extracting, G. F. Bogel 794,847
Telephone cut out, M. L. Smith 795,072
Telephone support, E. P. Baird 794,967
Telephone system, intercommunicating, De Veau & Auth 794,790
Tent structure, J. E. Walsh 795,080
Threshing grate, F. & E. Riedelsberger 794,888

Ticket for fabrics, clothing, etc., pin, J. C. St. John ... 795,240
Time recorder, R. Dey ... 795,204
Tire and rim, vehicle, F. A. Seiberling ... 795,016
Tire, vehicle, F. A. Seiberling ... 794,816
Tire, vehicle wheel, F. Sadler ... 795,171
Tobacco pipe, cigar holder, or the like, R. T. Sharman ... 794,893
Tool, fluid pressure impact, C. K. Pickles ... 794,738
Top prop, Robertson & Douglass ... 794,889
Toy, F. Maier ... 795,049
Track fastening, F. Smith ... 795,071
Train staff systems, staff hoop pouch for high speed, W. A. D. Short ... 795,070
Tramway points, means for operating, J. Levy ... 794,869
Trap door, C. W. Baldwin ... 794,968
Triangle, draftsman's, A. C. Loomis ... 795,145
Trolley ear, M. M. Wood ... 795,016
Trolley pole attachment, P. H. White ... 794,964
Trousers retainer, S. Reiter ... 795,064
Truck, P. Pray ... 794,741
Truck and hoist, combined hand, W. G. Magoffin ... 795,147
Trunk or baggage lifter and carrier, G. W. Payne ... 795,060
Truss, J. J. Horn ... 795,130
Tug, hame, N. Guthrie ... 794,977
Tuning hammer, Bediant & Ellsworth ... 794,772
Tunneling, J. C. Meem ... 795,148
Turbine reheater, elastic fluid, O. Junggren ... 794,863
Turbine, steam or gas, J. Stumpf ... 794,898
Turbines, emergency governor for elastic fluid, Garroway & Gray ... 794,857
Turbines, operating multistage, A. R. Dodge ... 795,256
Turnbuckles, forming, Laughlin & Christensen ... 794,944
Twisting and spinning machine, A. Klein ... 794,866
Typewriting machine, W. H. Campbell ... 794,851
Typewriting machine, B. C. Stickney, 794,896, 794,897
Typewriting machine, A. T. Brown ... 794,923
Typewriting machine ribbon actuating and shift mechanism, G. W. Campbell ... 795,192
Umbrella drainer, M. E. Hall ... 794,710
Umbrella, folding and telescoping, Shaffer & Webster ... 795,175
Vacuum pan, J. Abraham ... 794,831
Valve, W. O. Gunckel ... 795,220
Valve, air brake, D. S. & J. W. Gilbert ... 794,975
Valve, air brake triple, O. A. Alexander ... 794,835
Valve attachment, engineer's brake, Turner & Lewis ... 794,754
Valve, blow off, J. B. Barnes ... 795,187
Valve controlling mechanism, gas engine, G. H. Ellis ... 794,794
Valve, cylinder drainage and relief, B. J. Jones ... 795,134
Valve, heating system relief, A. McGonagle ... 795,053
Valve mechanism, slide, L. M. Pettit ... 795,165
Valve, rotary, J. Cruikshank ... 795,198
Valve seat, E. H. Lunken ... 794,808
Vapor apparatus automatic starter, M. Von Recklinghausen ... 794,745
Variable pressure engine, C. L. Pagenhart ... 794,882
Vehicle, T. Wilson ... 795,086
Vehicle brake, C. H. Longenecker ... 795,144
Vehicle steering gear, motor, J. E. Kimble ... 794,716
Vehicle wheel, E. Mari ... 794,725
Vending machine, E. Shaw ... 794,748
Ventilating heater, C. B. Holding ... 795,129
Vessel, A. Nelson ... 795,002
Vessel rig, sailing, B. W. Collins ... 795,025
Voting machine interlocking mechanism, P. Yoe ... 794,914
Vulcanization, A. L. Comstock ... 795,026
Wagon, dumping, Sasse & Conaway ... 795,172
Washboard liquid supply apparatus, J. A. De Vito ... 795,203
Washing machine gearing, W. H. Voss ... 794,823
Water bag stopper holder, A. C. Coe ... 794,782
Water distributing system, K. K. Kissell ... 795,138
Water gun, C. H. Radcliffe ... 794,743
Water heater, H. J. Blanke ... 794,846
Water heater, M. Flatland ... 794,931
Water power, M. Knickerbocker ... 794,988
Weeders, fastener for teeth for, Kendig & McCune ... 794,986
Weighing machine, L. Dreyfus ... 795,206
Well pipe attachment, perforated, F. M. Kleckner ... 794,943
Well tube wrench jack, oil, E. C. Miller ... 794,945
Wheel. See Stone polishing wheel.
Wheel, H. H. Porter, Jr. ... 794,740
Wheel rim, J. M. Padgett ... 794,879
Wheels and rails, device for increasing the adhesion between, R. C. Lowry ... 794,871
Wheels, automatically lubricating, W. K. Richardson ... 794,746
Wheelbarrow, A. O. Hubbard ... 795,041
Wind wheel, W. T. Fine ... 794,706
Windlass, portable, J. A. Woodworth ... 794,765
Window strip, Harris & Donaldson ... 795,120
Wire articles, machine for making, Ellis & Chadwick ... 795,209
Wire card racks, machine for making, G. R. Flowers ... 795,214
X-ray tube shield and support, Custer & Allen ... 794,788

DESIGNS.

Clock case, T. B. Stephenson, Jr. 37,496, 37,497
Mirrors, brushes, or similar articles, back for hand, M. K. Thomas ... 37,495
Pendant, G. Fox ... 37,494

LABELS

"Agabus," for cigars, Schmidt & Co. ... 12,274
"Eat What You Like Little Dube Laxative Tablets Will Keep You All Right," for laxative tablets, Du Quesne Universal Pharmacal Co. ... 12,276
"Gregg's Rattlesnake Oil Liniment," for medicine, Thomas & Smith ... 12,275
"Helen Byron," for cigars, Cole Lithographing Co. ... 12,273
"Orgue de Salon," for organs and parts of organs, G. A. Audsley ... 12,282
"Perfection Water Elevator and Purifier," for water elevators and pumps, St. Joseph Pump Co. ... 12,283
"Purity Peaches," for canned peaches, Lewin-Meyer Co. ... 12,280
"Purity Salmon," for canned salmon, Lewin-Meyer Co. ... 12,278
"Purity Tomatoes," for canned tomatoes, Lewin-Meyer Co. ... 12,279
"Queen's County Dingle Bay Linen," for linen, Mannheimer Bros. ... 12,281
"The Famous Kappelberg Vineyard Wines," for wines, A. Vogt ... 12,272
"The Geo. C. Mansfield Co.'s Pasteurized Creamery Butter, Jersey Brand," for butter, George C. Mansfield Co. ... 12,277

PRINTS.

"A Glove Contest," for gloves, J. Adler & Co. ... 1,374
"Admiral Togo's Strategy Puzzle," for puzzles, E. G. Johnson ... 1,377
"At Sea and Playmates Backs, Congress Playing Cards," for playing cards, United States Playing Card Co. ... 1,379
"Benefactor," for cigars, United Cigar Stores Co. ... 1,376
"Rose and Mountaineer Backs Congress Playing Cards," for playing cards, United States Playing Cards Co. ... 1,378
"She Likes It," for quinin shampoo hair invigorator, Federal Lithograph Co. ... 1,373
"The Battleship Brand Girl in Japan," for overalls and coats, Battleship Manufacturing Co. ... 1,375

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